

Report 1

Adequacy of the Postal Service's TFP Model

Final Report

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Measuring Postal Service Efficiency
PRC Contract 109909-17-Q-0014

Northwest Postal Consulting
for the
Postal Regulatory Commission



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I. Executive Summary

Northwest Postal Consulting (NWPC) is tasked with performing a two-part review of the U.S. Postal Service's Total Factor Productivity (TFP) measurement. The first part is a review of how accurately TFP measures productivity in today's environment. This includes an examination of any additional factors or methodology adjustments that might make TFP a more effective measurement. The second part of the review is to assess Postal Service efficiency over two distinct timelines, for the periods before PAEA and after PAEA. It will include an assessment of how well the Postal Service responded to revenue restrictions imposed by price caps as well as the impact of exogenous events.

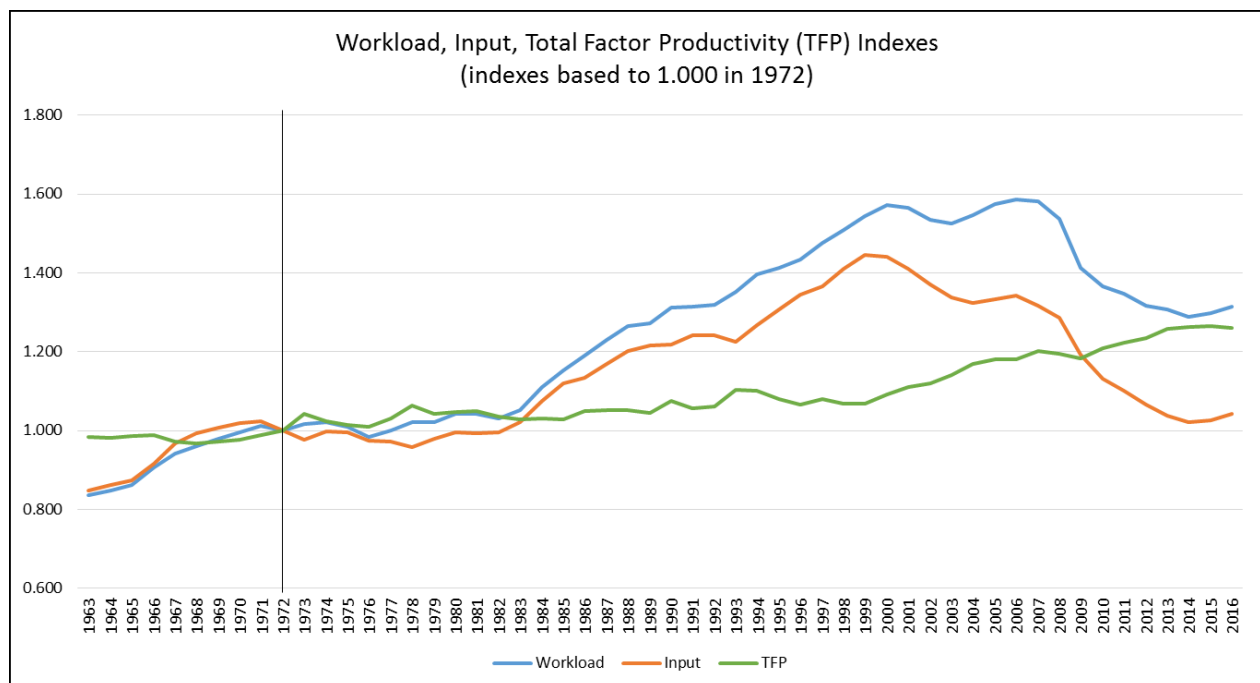
Report 1 provides a detailed review of the methodology used to calculate TFP. TFP results have been calculated for the Postal Service by Christensen Associates since inception in the late 1980's. There is very limited documentation explaining TFP in practical terms. The reports published by the Postal Service are a values-only Excel file. Individual tables in the report cover different time periods using TFP specific terminology that is not defined or explained. As a result, TFP is not understood beyond a general conceptual level. Yet, it is widely accepted as an overall measure of productivity for the Postal Service and reviewed in Annual Reports and special studies.

NWPC created an Excel-based TFP model to duplicate the methodology used by Christensen Associates to generate TFP. Over the years, the methodology has remained constant, while changes in mail classification, reporting systems, employee categories, transportation, and other factors required adjustments to the default formulas. NWPC determined that the methodology is accurate in calculations, adjustments were appropriate, and the results are valid. The only aspect to the methodology that introduces further discussion is the weighting value used to balance the workload between mail volume with possible deliveries.

NWPC restructured the published TFP reports to provide a functional format for analysis and modeling. These reports cover a period of 54 years of postal history, starting in 1963. These are presented in Appendix 1. These results are presented in graph form in this report. It is important to understand how TFP is structured to fully appreciate the wealth of information contained in the data and results. The first part of this report explains the methodology using a single year as an example. A detailed explanation of this single year example is included in Appendix 2.

TFP is a productivity measure, calculated by dividing the output, or Workload, by the input, or resources used. TFP Workload is comprised of Weighted Mail Volume, Miscellaneous Output, and Possible Deliveries. Input is comprised of Labor, Materials, and Capital. Each of these are combined into a single index value. Econometric principles are used to create these indexes. TFP results are shown in Figure 1.

Figure 1: U.S. Postal Service Total Factor Productivity – 1963 to 2016



The results of the detailed review of the methodology led to three basic questions. These are discussed in detail in Section IV.

- Is the model complete and accurate? At this point, the answer is yes. It includes all aspects of inputs and outputs using an effective methodology.
- Is the model relevant? In short, the answer is yes. There is a surprising level of detail regarding different aspects of Labor, Capital, Materials, Mail Volume, and Possible Deliveries. TFP could provide much more value than the single number that is reported in a couple of paragraphs in an annual report.
- Is the Model transparent? The answer is no. TFP is generally accepted yet how it is calculated or what it really means is not widely understood.

In summary, the TFP methodology is relevant and valid. The current presentation is not relevant or transparent. The results are generally not used. The model results could be used to analyze the impact of strategic programs, management initiatives, and operational processes on productivity performance. A review of the weighting factor for mail volume and possible deliveries would be appropriate, leading to a better understanding of the impact of the delivery network growth.

This report is intended to set up the assessment of the Before and After PAEA periods. As such, the report reviews a number of methodology adjustments that might make TFP a more effective measurement. These are applied in Report 2 in parts of the productivity analysis in the Before and After PAEA periods.

II. TFP Methodology

Total Factor Productivity (TFP) is a widely accepted methodology for measuring broad productivity. The TFP methodology for the Postal Service was developed by Christensen Associates in the late 1980's. It has been maintained by them over the years. The basic methodology has not changed since the original design. There have been appropriate adjustments to the methodology over the years as postal products and reporting methods have evolved.

The methodology used to calculate TFP involves a complex series of calculations. The published data and results are organized based on the evolving nature of mail classification, organizational structure, and data reporting systems. The data and results were reorganized to support this project. The result of this reorganization is presented as Appendix 1 - Published TFP Data & Results. Some additional results are added in these reports. For example, a historical wage rate report was added.

NWPC has developed an Excel based model to calculate TFP. The methodology used to calculate TFP is explained through a single year example using this model. This NWPC TFP Model validates the published result and makes it easier to understand the detailed methodology. This NWPC TFP Model also evaluates different methodology alternatives in a later section.

1. Project Background

The PRC provides the best descriptions to set the background for the project in their Request for Proposal¹ document:

- *In the face of growing technological and other changes, the PRC believes that it is important to review the Postal Service's TFP model and productivity measurements to ensure that they are reliable and accurate.*
- *The TFP model is an index of outputs (workload) to inputs (resource usage). The Postal Service's main outputs are mail volumes handled and servicing the delivery network. Inputs include labor, capital and materials. Resources are weighted for each mail type according to its workload content which includes factors such as size, weight, mailer preparation, and modes of transportation used.*
- *In Report 1, the PRC seeks a thorough review of how accurately TFP measures changes in productivity in a network industry that has undergone significant technological changes and outsourcing (in the form of work- sharing).*
- *This review will include an examination of what, if any, additional factors should be included to improve the productivity measure.*

¹ Request for Proposal for Measuring Postal Service Productivity, November 15, 2016, pages 4-5.

- *The goal of Report 2 is to assess Postal Service efficiency improvements over two distinct timelines, prior to and after passage of the PAEA. The first timeline will be from FY 1991 through FY 2006. The second timeline will be from FY 2007 through FY 2016. The examination will decompose the TFP results to isolate how well the Postal Service responded to revenue restrictions imposed by the price caps as well as the exogenous events that occurred since the PAEA was passed.*

2. Model Development & Validation Process

A. Reference Documents

NWPC has been using the following documents as source material on the TFP methodology. These are provided as Appendix 3.

1. The document “Electronic Attachment to Postal Service Response to MPA/USPS-T2-3.b, Formulas for Total Factor Productivity, Labor Productivity, Postal Inflation, and the Aggregate Labor Price Index” (PRC Filing ID: 68582, Accepted 6/23/2010) is in the PRC Library. This document provides a basis for understanding the TFP calculation methodology.
2. Memorandum from Christensen Associates, Introduction and Elimination of Inputs, January 30, 2017. This document explains the methodology used to adjust the default formulas when an input is added or removed to one of the components.
3. Memorandum from Christensen Associates, Further Explanation of Capital Input Calculations, January 30, 2017. This document explains the process used to calculate the Capital components of TFP.
4. Memorandum from Christensen Associates, Econometric Estimation of Network and Output Cost Elasticities, February 2, 2017. This document explains the methodology and history of the weighting used for creating the final Workload from Weighted Mail Volume, Miscellaneous Output, and Network (Possible Deliveries).
5. Memorandum from Christensen Associates, Impact of 2004 Accounting Change on TFP Tables, February 2, 2017. This document explains changes due to the switch from 4-week Accounting Periods to monthly reporting.
6. NWPC documented the TFP Validation process through a set of written questions that were answered by Christensen Associates. These are provided along with the supporting Excel reports.

A further reference, but not provided in Appendix 3, is an explanation of TFP as originally designed, but at a more conceptual level. It is the paper *U.S. Postal Service Productivity: Measurement and Performance*, Christensen, Christensen, Guy, and O'Hara, M.A. Crew and P.R. Kleindorfer, eds., Regulation and the Nature of Postal and Delivery Service, (Springer, 1993), pp. 237-259.

These documents were used to validate the TFP methodology through the development of an Excel model.

B. Key Concepts & Definitions

The following definitions are used in the TFP methodology.

1. Quantity: This is the result of the calculation of the chained value calculation process. It starts out with a seed or starting value in the base year. In general it is set to the pieces or cost for that base year. Typically, 1972 is used as the base year.
2. Value: This is used for the value of the component. It is usually dollar based, either in current dollars or indexed dollars to a base year.
3. Composition of Labor Factor: A component is used in the Labor quantity calculation to reflect the experience level of employees. In general, this becomes a proxy for the changes in wage rate based on the current mix of employees within a category.
4. Composition Hours: This is the actual workhours multiplied by the Composition Index. It is used in the Quantity calculation process instead of actual workhours.
5. Chained Value Index: This is the process using the Tornqvist Index methodology to calculate Quantity for labor occupation categories that have different types of employees. The value is based, in part, on the previous year's quantity.
6. Base Year Index: This is the process that calculates Quantity based on a fixed base year, usually 1972. It is used for occupation categories that have a single type of employee.
7. Growth Rates: Growth rates are shown in the published reports. The Growth Rate is calculated using the natural logarithm formula rather the traditional percentage change over the previous year. The use of a logarithm formula allows the values for individual years to be added together directly to get the cumulative growth over multiple years.
8. Weighted Mail Volume: The result of the index calculation to combine the change in pieces with the share of the attributable cost for Mail Products and Classes.
9. Miscellaneous Output: The component of output from Ancillary Services, Special Services, Competitive Services, and Other Services.
10. Total Output: Total Output is the combination of the Weighted Mail Volume and the Miscellaneous Output.
11. Network: Network is the component of workload that represents the delivery network. It is the Possible Deliveries for the Postal Service.
12. Workload: Workload is the combination of the Total Output (weighted mail volume and Miscellaneous Output) and the Network (Possible Deliveries). It is the numerator in the general productivity equation.
13. Input: Input is the composite index of the Labor, Materials, and Capital components. It is the denominator in the productivity equation.
14. Total Factor Productivity (TFP): It is the Workload divided by the Input.
15. Labor Productivity Index: It is the Workload divided by the Aggregate Labor Index (instead of Input).
16. Postal Inflation Index: The index of the Resources Value (current dollars of Labor and materials, and value of Capital) divided by the Workload.

C. Key Validation Results & Status

The validation process has not identified any significant methodology or calculation concerns with the TFP results. Christensen Associates has made appropriate methodology changes and calculations adjustments over the approximately 27 years of TFP use. The following are the key results from the validation process:

1. The Labor Input model was almost identical to the published results.
2. In 2004, a change from 4-week Accounting Periods to Monthly accounting results in minor differences to published results. This change results in an ongoing minor adjustment of results in some categories.
3. In the published reports, a "Price" is calculated using the Value and the Quantity results. This is not used directly in the methodology and is provided to show the relationship between the two measures. In some cases, the calculated value differs from the published value for Price. This is related to the 2004 accounting method change. This does not impact model results.
4. The process for Capital involves a detailed methodology that is done on a quarterly basis. Our validation process did not involve a review of the capital methodology calculations. There is no reason to suspect any issues exist with the results from capital process.
5. For Mail Volume, in 2008, there were major changes in mail classification categories due to PAEA. The TFP model used this change to reset the Quantity baseline to 2008 pieces. Over the years, the quantity result for weighted mail volume diverges from the actual number of pieces. This can introduce distortion in results, as for some Mail Products, the Quantity equals the number of pieces. This results in a factor to make an adjustment to the final Workload. This appears to be an appropriate adjustment methodology. The actual calculation of the adjustment factor could not be verified.
6. The methodology for creating the International Quantity and the category "International and Other Mail" Quantity has a definition that changes several times since 2008. For example, Express Mail and Priority Mail were moved into the Other category in 2013 in the TFP tables. This is an example of the transparency issue discussed in the findings.
7. The weighting factor used to combine Weighted Mail Volume and Network (Possible Deliveries) changed in 2016. This is explained in the memorandum from Christensen Associates. This weighting factor has a major influence on the final TFP result. It is discussed in detail in the assessment of productivity in the Before and After PAEA periods.

The details of the validation process are documented in Appendix 3 through the written questions and responses from Christensen Associates.

3. Single Year Example

A detailed example is used to demonstrate the calculation of TFP for the year 2010. This year was picked to be representative of the process and issues in the TFP methodology. This example is provided as a separate Excel model that has formulas showing the actual calculation steps. A detailed explanation is provided to accompany the Excel model. The explanation document is summarized in this section. Appendix 2 provides the full detailed document.

A. Single Year Explanation Approach

This document uses the following approach to explaining the TFP methodology:

1. Source data is shown in the Excel file in a blue font.
2. Quantity is calculated as a chained value. Quantity is the term used for the result of the productivity calculation for a TFP component. The current year's quantity is calculated based on the previous year's quantity value. Accordingly, the example uses the 2009 quantity value as a given in showing the calculation methodology.
3. The chained calculation requires a starting, or seed, value to start the Quantity calculation. These seed values are shown in a blue highlight in the Excel file.
4. The structure shows all categories used throughout the 54 years of TFP data history (1963 through 2016). If a category is not used in 2009 or 2010, it is shaded. These are included to show the history of the categories used through the years.
5. In some cases, the calculation formulas result is different than the published TFP value. Generally, these are the result of an appropriate adjustment by Christensen Associates. These are shown in a pink highlight.
6. In some cases, an adjustment is made using a defined change to the default formula calculation. These adjustments are shown in an orange highlight.
7. Christensen Associates provided additional explanation of the adjustment process used where categories changed from one year to the next. This is provided in Appendix 3.
8. Some of the data used in TFP is Non-Public. This data is shown in green highlight. For the purposes of this document, these values are masked to allow this document to be shared beyond the Non-Public data restrictions.
9. There are changes in the categories and data structure over the 63 years of TFP historical data. This example shows all categories used over this period. Where a category was not active in 2009 or 2010, it is shown in the listing with the cells shaded out in the data section. This was done to provide a full listing of the categories used over the years.

B. Labor Quantity Input

The Labor Input uses both the Chained Value and the Base Year methodologies. These are combined to create an Aggregate Labor Quantity. It is a two-step process. The detailed steps are shown using the following figures of the Excel model example and calculation flow charts.

In general, a two-step process is used. The first step is to calculate the Quantity for each Occupation category. The following Occupation categories are used in TFP:

1. Postmasters
2. Supervisors
3. Clerks / Mail Handlers
4. City Carriers & Vehicle Service Drivers
5. Special Delivery
6. Rural Carriers
7. Maintenance Service
8. Vehicle Service
9. Professional, Technical & Administration
10. Other Personnel

Employee categories of full-time, part-time, and non-career are used for those occupations where the distinction is valid for productivity measurement purposes.

There are three data elements used in the Labor Quantity calculation:

1. Total Dollars: This is the total Salary & Benefits dollars.
2. Composition of Labor factor: This is a factor that is calculated in a separate process to represent employee experience. It is discussed in detail in a later section.
3. Hours: Workhours by employee category.

The Composition of Labor factor is multiplied by the Hours to get "Composition Hours". This result is used in the Quantity result.

The Tornqvist Index process is used to calculate the Quantity where there are multiple employee types within the occupation category. The following formula is used to calculate the quantity:

$$\Pi \left(\frac{\text{Current Year Composition Hours}}{\text{Previous Year Composition Hours}} \right)^{(\% \text{ CY Dollars} + \% \text{ PY Dollars})/2} \times \text{Previous Year Quantity}$$

The formula calculates the ratio of composition hours of the current year to the previous year, raised to the power of the average percentage dollars for the category. This result is multiplied together for each of the employee categories, and then multiplied by the previous year's quantity value. In the first year, generally 1972, the actual dollars for the year is used to start the chained calculation process.

Where the Occupation category has only a single employee type, a base year methodology is used. It calculates the quantity by indexing the composition hours to the 1972 base year value.

The second step is to aggregate the Quantity results from the first step into a single Labor Quantity result. It uses the same Tornqvist Index process to calculate the index value for each, then multiplies them together, and then multiplies that result by the previous year's Aggregate Labor Quantity.

C. Capital Quantity Input

The data provided for the Capital Value and Quantity are provided in this section. The methodology for Capital is almost entirely done in a separate process. Capital is calculated on a quarterly basis using a perpetual inventory process. It is explained in detail in the 2010 PRC TFP Methodology paper. Christensen Associates provided additional explanation for this project. Their memorandum is provided in Appendix 3.

D. Materials Quantity Input

The Materials Quantity is calculated from cost data for 30 categories comprising Materials resources used for the year. In 2016, the number of categories was reduced to 28. The methodology is explained in detail in the Appendix 3 documents.

The general process is to convert the current year dollars into an indexed value using a Bureau of Labor Statistics (BLS) index specific to the category. However, where the category is USPS specific, such as the Air Contracts, a methodology was developed by Christensen to fit the specific characteristics of the category.

In validating the methodology, an adjustment factor was identified that is applied starting in 2004. This factor is different for each category.

Once the Quantity is calculated for each category, these are combined into a single Aggregate Material Quantity using the Tornqvist Index methodology.

Figure 2: Labor Quantity Calculation - Labor Categories

Total Factor Productivity - Methodology Example using 2009 / 2010 Data																	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
Calculation of Labor Category Quantity																	
Labor Category		Employee Category	Previous Year - 2009				Current Year - 2010						Base Year 1972 (1985 for Admin)			2010 Quantity	
			Value: Labor Dollars	% Labor Value	Labor Hours	Labor Composition Index	Composition Hours	2009 Quantity	Value: Labor Dollars	% Labor Value	Labor Hours	Labor Composition Index	Composition Hours	Index Factor	Value: Labor Dollars		Labor Hours
1	Clerks &	Full-time															
2	Mail Handlers	Part-time															
3		Full-time	12369.5	66.3%	263.5	1.002	264.0	11080.1	64.9%	232.2	1.004	233.0	0.921				
4	Clerks	Part-time	1871.2	10.0%	43.3	1.011	43.8	1792.1	10.5%	40.5	1.020	41.3	0.994				
5		Non-Career	232.7	1.2%	14.4	1.000	14.4	174.1	1.0%	11.4	1.000	11.4	0.997				
6		Full-time	3905.4	20.9%	85.0	0.998	84.9	3775.4	22.1%	80.3	1.001	80.4	0.988				
7	Mail Handler	Part-time	214.3	1.1%	5.7	0.999	5.7	208.3	1.2%	5.1	1.020	5.2	0.999				
8		Career															
9		Non-Career	67.7	0.4%	4.4	1.000	4.4	47.9	0.3%	3.4	1.000	3.4	0.999	Mainten			
10	Clerks & Mail Handlers		18660.7		416.3		417.2	17077.9		372.9		374.7					2318.1
11	Carriers &	Full-time															
12	VS Drivers	Part-time															
13		Full-time	15396.1	82.9%	326.9	0.989	323.2	15156.7	82.8%	313.9	0.992	311.5	0.970				
14	City Carriers	Part-time	1677.7	9.0%	40.8	0.977	39.8	1685.7	9.2%	38.8	0.987	38.3	0.996				
15		Career															
16		Non-Career	768.8	4.1%	27.9	1.000	27.9	781.6	4.3%	27.8	1.000	27.8	1.000				
17		Full-time	658.5	3.5%	13.5	0.983	13.3	628.6	3.4%	12.7	0.986	12.5	0.998				
18	Vehicle Services	Part-time	65.5	0.4%	1.6	0.971	1.6	56.3	0.3%	1.3	0.979	1.3	0.999				
19	Drivers	Career															
20		Non-Career	6.9	0.0%	0.3	1.000	0.3	7.1	0.0%	0.3	1.000	0.3	1.000				
21	City Carriers & Vehicle Service Drivers		18573.4		411.0		406.1	18316.0		394.8		391.6					2400.5
22		Full-time															
23	Special Delivery	Part-time															
24		Non-Career															
25	Special Delivery																
26		Full-time	5369.7	80.3%	122.9	0.931	114.4	5395.0	80.7%	121.0	0.936	113.2	0.992				
27	Rural Carriers	Part-time	318.1	4.8%	12.8	0.931	12.0	328.5	4.9%	13.1	0.936	12.3	1.001				
28		Career															
29		Non-Career	1003.4	15.0%	45.8	1.000	45.8	963.3	14.4%	43.5	1.000	43.5	0.993				
30	Rural Carriers		6691.1		181.5		172.2	6686.8		177.6		169.0					969.7
31		Full-time	3592.2	98.7%	73.7	1.024	75.5	3484.8	98.7%	70.1	1.027	72.0	0.953				
32	Maintenance	Part-time	35.6	1.0%	0.9	1.039	0.9	32.7	0.9%	0.8	1.047	0.8	0.999				
33	Service	Career															
34		Non-Career	10.2	0.3%	0.7	1.000	0.7	12.6	0.4%	0.9	1.000	0.9	1.001				
35	Maintenance Service		3637.9		75.3		77.1	3530.0		71.8		73.7					461.4
36		Full-time	496.6	99.7%	10.3	0.996	10.3	481.0	99.7%	9.8	0.998	9.8	0.949				
37	Vehicle	Part-time	1.6	0.3%	0.0	1.014	0.0	1.4	0.3%	0.0	1.014	0.0	0.999				
38	Service	Career															
39		Non-Career	0.1	0.0%	0.0	1.000	0.0	0.1	0.0%	0.0	1.000	0.0	1.000				
40	Vehicle Service		498.3		10.4		10.3	482.4		9.8		9.8					70.3
41	Postmasters		2461.9					2471.9		54.7	1.022	55.9		428.2	67.2	0.980	363.8
42	Supervisors		3481.3					3324.6		62.7	0.995	62.4		641.9	78.7	1.007	505.6
43	Admin & Technical		772.0					665.7		12.3	1.055	13.0		247.2	13.5	1.000	238.9
44	Other Personnel		1672.4					1685.1		26.3	1.029	27.1		171.6	21.5	0.994	217.3

Figure 3: Flow Chart - Calculation of Labor Category Quantity

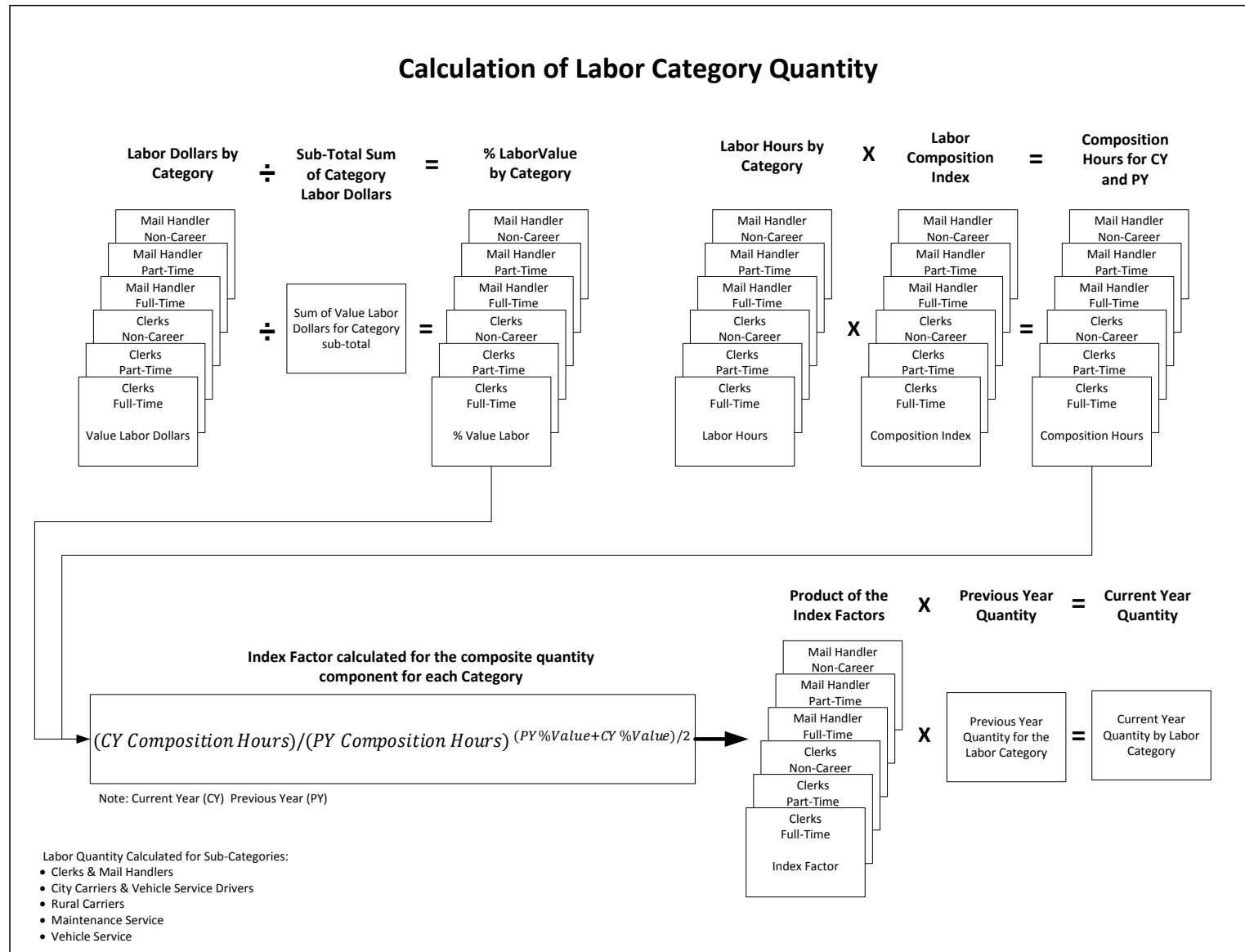


Figure 4: Flow Chart – Calculation of Aggregate Labor Quantity

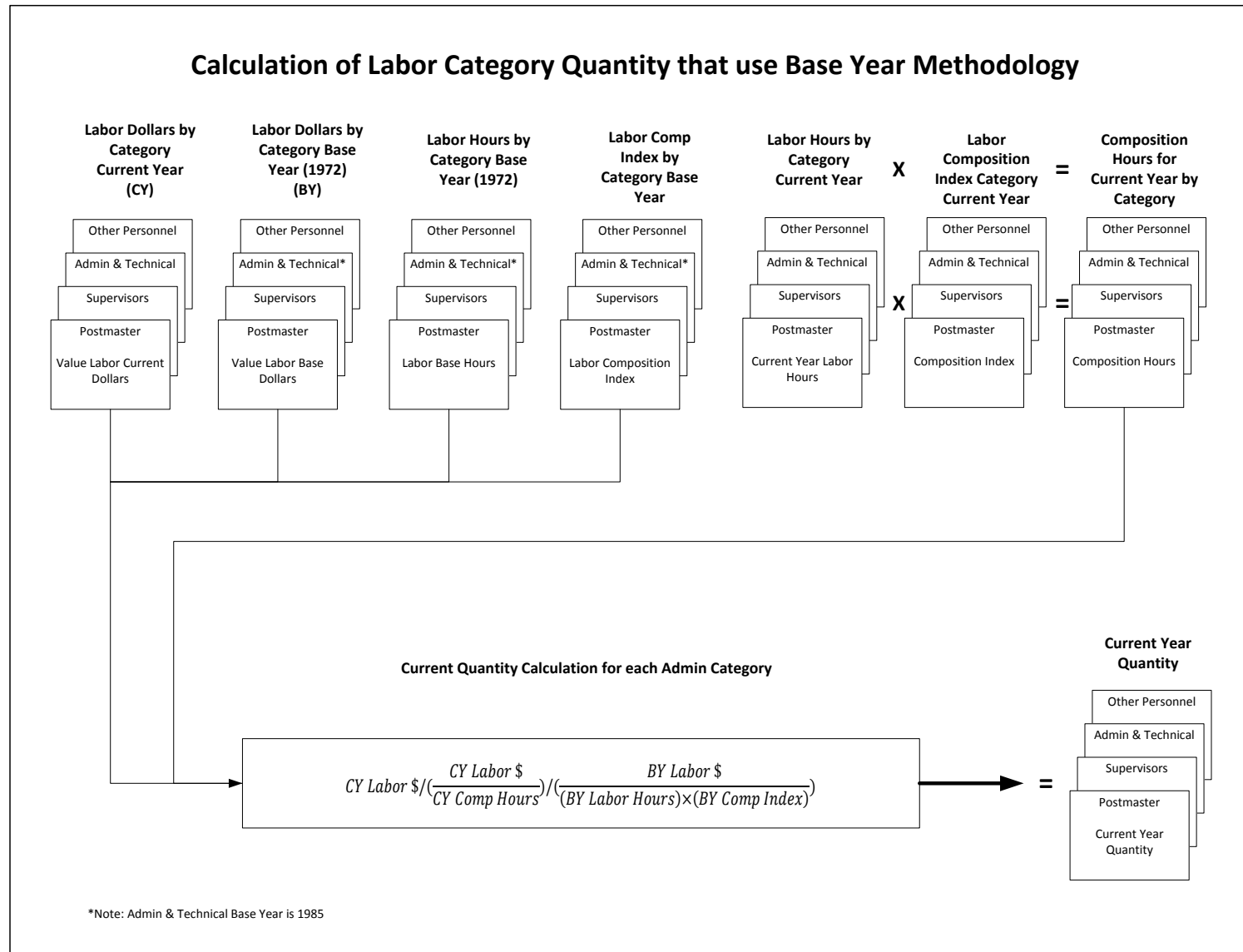


Figure 5: Aggregate Labor Quantity Calculation

Total Factor Productivity - Methodology Example using 2009 / 2010 Data																					
	A		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P				
Calculation of Aggregate Labor Quantity																					
Employee Category	Labor Category	Previous Year - 2009					Current Year - 2010							2010 Quantity							
		Labor Dollars	% Labor	Labor Hours	Labor Composition Index	Composition Hours	2009 Quantity	Labor Dollars	% Labor	Labor Hours	Labor Composition Index	Composition Hours	Index Factor								
45	Clerks & Mail Handlers	18660.7	33.1%				2572.6	17077.9	31.5%				0.967				2318.1				
46	City Carriers & VS Drivers	18573.4	32.9%				2491.4	18316.0	33.8%				0.988				2400.5				
47	Special Delivery																				
48	Rural Carriers	6691.1	11.9%				984.2	6686.8	12.3%				0.998				969.7				
49	Maintenance Service	3637.9	6.4%				483.9	3530.0	6.5%				0.997				461.4				
50	Vehicle Service	498.3	0.9%				74.1	482.4	0.9%				1.000				70.3				
51	Postmasters	2461.9	4.4%				363.6	2471.9	4.6%				1.000				363.8				
52	Supervisors	3481.3	6.2%				539.7	3324.6	6.1%				0.996				505.6				
53	Admin & Technical	772.0	1.4%				285.0	665.7	1.2%				0.998				238.9				
54	Other Personnel	1672.4	3.0%				219.7	1685.1	3.1%				1.000				217.3				
Aggregate Labor Quantity		56449.0	100.0%					7829.0	54240.5				100.0%								7388.1

Figure 6: Calculation of Aggregate Labor Quantity

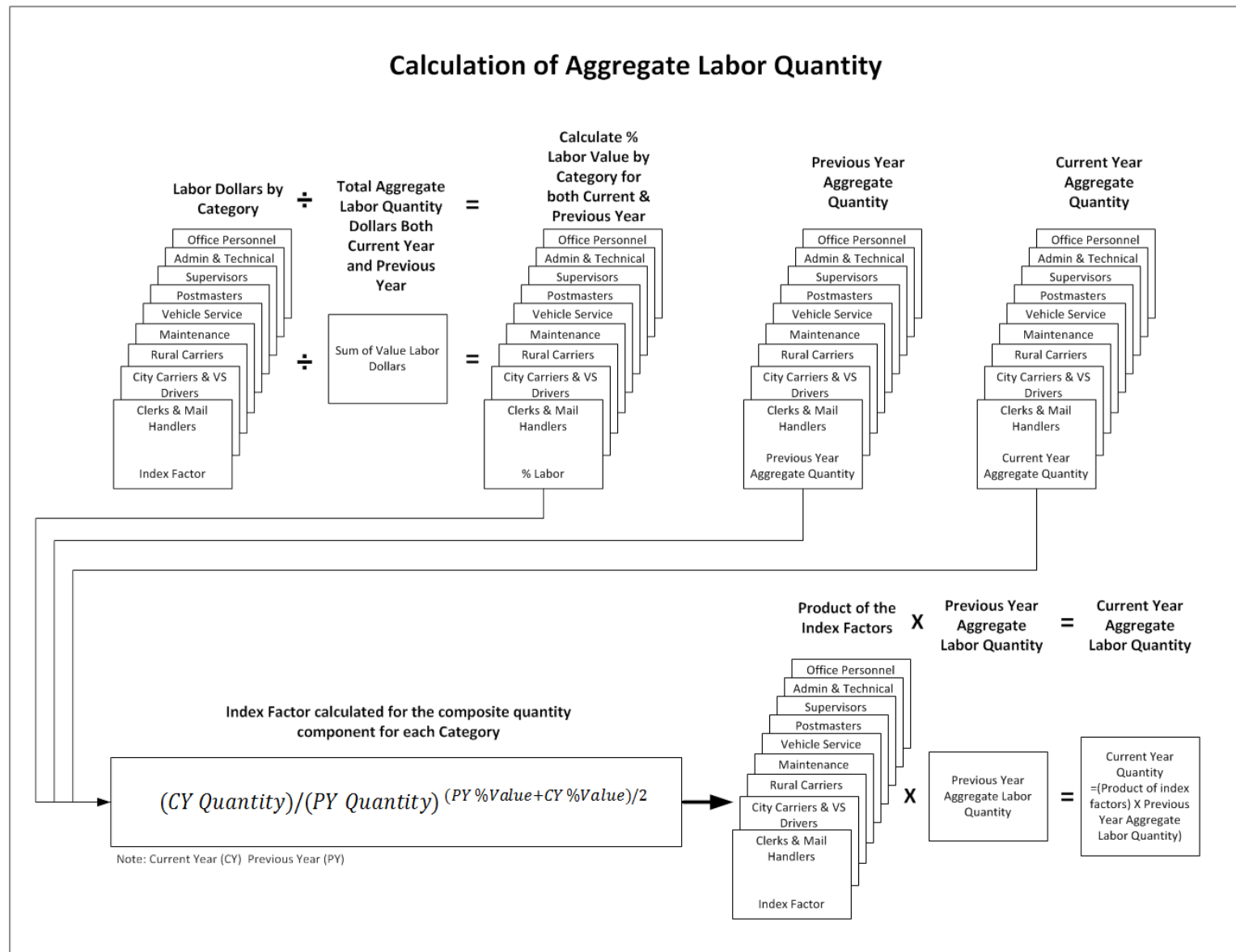


Figure 7: Capital Quantity Calculation

Total Factor Productivity - Methodology Example using 2009 / 2010 Data												
Calculation of Capital Quantity												
	Previous Year - 2009						Current Year - 2010					
	Asset Price Index	Investments & Transfers	Real Investment	Owned Capital Stock	Value	Quantity	Asset Price Index	Investments & Transfers	Real Investment	Owned Capital Stock	Value	Quantity
1 Land Owned	6.259	34.1	5.4	1407.6	149.4	62.9	5.832	-3.5	-0.6	1407.0	176.1	62.9
2 Buildings Owned	5.438	1041.7	191.6	5968.7	1321.5	158.4	5.272	835.3	158.4	5989.2	1864.8	160.5
3 Rented					1030.6	207.7					1022.3	205.3
4 Composite					2352.2	456.3					2872.0	457.7
5 Vehicles Owned	2.702	50.5	18.7	192.3	146.6	54.9	2.781	53.8	19.3	166.3	136.5	51.1
6 Customer Service Equipment Owned	1.975	1.1	0.6	285.1	87.6	47.4	1.987	0.1	0.1	254.6	76.1	42.4
7 Postal Support Equipment Owned	0.078	330.7	4251.3	17929.2	559.6	5225.6	0.071	269.7	3777.6	16626.1	559.6	5225.6
8 Rented					78.9	737.2					78.9	737.2
9 Composite					654.4	5501.4					559.6	5225.6
10 Mechanized Handling Equipment Owned	3.053	212.7	69.7	1698.2	593.7	261.5	3.047	106.6	35.0	1590.6	576.5	246.9
11 Automated Handling Equipment Owned	0.737	0.3	0.4	3496.5	403.3	765.0	0.739	73.2	99.0	3299.7	359.0	708.2
12 Total Capital					4444.6	1570.8					4829.0	1535.5

Figure 8: Materials Quantity Calculation

Total Factor Productivity - Methodology Example using 2009 / 2010 Data															
Calculation of Materials Quantity															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Materials Category	Previous Year - 2009					Current Year - 2010					Calculation of Quantity - 2010				
	Actual Dollars	% Cost (Dollars)	1972 Price Index	2004 Adjustment Factor	2009 Quantity	Actual Dollars	% Cost (Dollars)	1972 Price Index	2004 Adjustment Factor	2010 Quantity	Index Factor	Calculated Aggregate Quantity	Published Aggregate Quantity	% Published	+/- Published
1 Air Domestic Network	1554.0	12.6%	2.650	-1.37%	594.7	1538.2	12.8%	2.832	-1.37%	550.7	0.990				
2 Air Domestic Contract	459.8	3.7%	3.712	-0.27%	124.2	438.3	3.7%	3.730	-0.27%	117.8	0.998				
3 Air International Line Haul	793.0	6.4%	2.066	0.20%	383.1	682.1	5.7%	2.004	0.20%	339.7	0.993				
4 Highway Transport	3013.3	24.4%	3.347	0.04%	899.8	3176.6	26.5%	3.327	0.04%	954.3	1.015				
5 Rail Transport	84.6	0.7%	2.489	-0.29%	34.1	25.0	0.2%	2.561	-0.29%	9.8	0.994				
6 Water & Other Transport	28.9	0.2%	4.985	-3.29%	6.0	30.4	0.3%	5.119	-3.29%	6.1	1.000				
7 International Terminal Settlements						422.4	3.5%	0.733	0.00%	576.0					
8 Misc Trans & Intl Terminal Dues	373.7	3.0%	12.747	3.09%	28.4										
9 International Terminal Charges	201.5	1.6%	3.852	2.25%	51.2										
10 Relocation Costs	6.2	0.0%	9.058	5.46%	0.6	4.9	0.0%	9.251	5.46%	0.5	1.000				
11 Transport of Household Effects	6.8	0.1%	3.347	-4.22%	2.1	7.5	0.1%	3.327	-4.22%	2.4	1.000				
12 Uniforms & Work Clothes	81.9	0.7%	2.145	1.15%	37.8	77.6	0.6%	2.148	1.15%	35.7	1.000				
13 Travel	134.0	1.1%	9.058	-0.02%	14.8	107.5	0.9%	9.251	-0.02%	11.6	0.998				
14 Supplies	895.7	7.3%	4.456	0.05%	200.9	866.0	7.2%	4.490	0.05%	192.7	0.997				
15 Contract Building Services	322.7	2.6%	6.345	0.04%	50.8	312.8	2.6%	6.392	0.04%	48.9	0.999				
16 Professional Services	851.1	6.9%	5.279	0.37%	160.6	841.6	7.0%	5.299	0.37%	158.2	0.999				
17 Contract Computer Services	374.6	3.0%	5.828	0.59%	63.9	360.6	3.0%	5.805	0.59%	61.8	0.999				
18 Heating Fuels	88.2	0.7%	11.248	0.27%	7.8	77.4	0.6%	10.814	0.27%	7.1	0.999				
19 Utilities	604.6	4.9%	5.634	-0.04%	107.4	560.6	4.7%	5.779	-0.04%	97.0	0.995				
20 Telephone	189.3	1.5%	1.049	4.12%	173.4	148.6	1.2%	0.982	4.12%	145.4	0.998				
21 Telegraph															
22 Vehicle Supplies	533.0	4.3%	7.099	-0.78%	75.7	579.1	4.8%	7.898	-0.78%	73.9	0.999				
23 Vehicle Maintenance	681.7	5.5%	7.099	-0.45%	96.5	716.3	6.0%	7.898	-0.45%	91.1	0.997				
24 Vehicle Rents	42.2	0.3%	2.678	-2.15%	16.1	33.2	0.3%	2.674	-2.15%	12.7	0.999				
25 Research and Development	15.5	0.1%	8.430	-11.55%	2.1	12.4	0.1%	8.478	-11.55%	1.7	1.000				
26 Expensed Building Improvements	219.5	1.8%	5.483	3.75%	38.6	192.1	1.6%	5.684	3.75%	32.6	0.997				
27 Maintenance	184.4	1.5%	6.345	0.51%	28.9	152.1	1.3%	6.392	0.51%	23.7	0.997				
28 Miscellaneous Services	504.6	4.1%	5.886	-13.84%	99.5	508.8	4.2%	6.011	-13.84%	98.2	0.999				
29 Miscellaneous Judgments	88.9	0.7%	4.224	0.20%	21.0	86.9	0.7%	4.260	0.20%	20.3	1.000				
30 Miscellaneous	20.7	0.2%	3.263	-49.60%	12.6	25.0	0.2%	3.342	-49.60%	14.8	1.000				
31 Total Miscellaneous															
32 Total Materials - Aggregate Quantity	12354.2	100.0%			2868.4	11984.1	100.0%					2762.1	2742.5	0.72%	19.6

E. Weighted Volume

General Information

1. The underlying data comes from the Revenue, Pieces and Weight (RPW) and Cost and Revenue Analysis (CRA) Reports.
2. There have been many changes in mail classification over the years. These classifications are shown to provide a full listing of the categories used in TFP.
3. Attributable Cost is used to weight the changes in piece volumes using the index process to calculate the quantity where there are multiple Mail Products within the Mail Class category.
4. Generally, In Mail Class categories where there is a single Mail Product, the Quantity equals the pieces.
5. Once a Quantity is calculated for each Mail Product, these are aggregated to create the Weighted Mail Volume Quantity. This is the final result for the mail volume component. It is based on the pieces and weighed using the Attributable Cost.

First Class Mail

The following process is used to calculate the Quantity for First Class Mail.

1. Columns A, E show the Pieces by Mail Product.
2. Columns B, C show the Attributable Cost by Mail Product.
3. Columns C, G show the calculated percentage of the Attributable Cost. This is used in calculating the factor index for each Mail Product.
4. Column H calculates the factor index for each Mail Product. It uses the ratio of the pieces, weighted by the average of the percentage of the Attributable Cost over the two years. This is expressed by the following formula:

$$\left(\frac{\text{Current Year Pieces}}{\text{Previous Year Pieces}} \right)^{(\% \text{ CY Cost} + \% \text{ PY Cost})/2} \times \text{Previous Year Quantity}$$

5. Column D, Line 12 shows the Prior Years published Quantity value.
6. Column I, Line 12, calculated the Current Year quantity using the Product of the index values multiplied by the previous year's Quantity.

This process is used for the other Mail Products that have individual Mail Class categories.

Figure 9: Quantity Calculation - First Class, Priority, Express Mail, Standard, & Periodicals

Weighted Mail Volume													
		A	B	C	D	E	F	G	H	I	J	K	L
		Previous Year - 2009				Current Year - 2010							
Mail Class	Mail Product	Pieces	Attributable Cost	% Cost (Dollars)	Published Quantity	Pieces	Attributable Cost	% Cost (Dollars)	Catetory Index	Calculated Quantity	Published Quantity	% Published	+/- Published
1	Single Piece Letters, Flats, Parcels												
2	Airmail												
3	Single-Piece Letters	30016.5	7902.0	44.5%		27195.7	7376.8	43.6%	0.957				
4	First Class Flats	2864.5	2157.5	12.1%		2487.3	2148.0	12.7%	0.983				
5	Parcels	580.8	1095.2	6.2%		575.3	1132.4	6.7%	0.999				
6	Single-Piece Cards	1616.8	440.0	2.5%		1439.5	398.6	2.4%	0.997				
7	Government Cards												
8	Presort Letters, Flats, Parcels												
9	Presort Letters	45109.2	5401.6	30.4%		43293.8	5161.8	30.5%	0.988				
10	Presort Cards	3126.0	241.0	1.4%		2931.6	237.0	1.4%	0.999				
11	Outbound Intl FC Letters, Flats, Packages	456.4	529.0	3.0%		323.6	476.1	2.8%	0.990				
12	Total First Class	83770.2	17766.3		83262.2	78246.7	16930.7			76267.5	76220.0	0.06%	47.5
13	Priority Mail	790.1				810.8				810.8	810.8	0.00%	0.0
14	Express Mail	47.0				42.6				42.6	42.6	0.00%	0.0
15	Single Piece												
16	Standard Commercial Regular												
17	Commercial ECR												
18	Nonprofit Regular												
19	Nonprofit ECR												
20	Nonprofit Books												
21	Regular												
22	ECR												
23	HD & Saturation Letters	5085.4	347.1	2.9%		5428.0	378.0	3.2%	1.002				
24	HD & Saturation Flats & Par	12356.8	796.7	6.5%		11363.4	796.3	6.7%	0.994				
25	Carrier Route	9902.0	1585.6	13.0%		9473.6	1567.2	13.3%	0.994				
26	Letters	46867.8	5101.9	41.9%		48508.6	5127.4	43.4%	1.015				
27	Flats	7814.5	3497.1	28.7%		7067.7	3169.2	26.8%	0.972				
28	Not Flat-Mach & Parcels	679.0	840.0	6.9%		682.4	780.2	6.6%	1.000				
29	Total Standard	82705.6	12168.4		81538.4	82523.7	11818.4			79740.3	79578.1	0.20%	162.2
30	Within County	859.3	105.1	3.9%		695.5	98.5	4.0%	0.992				
31	Periodicals Outside County	7094.4	2574.9	96.1%		6574.0	2391.3	96.0%	0.929				
32	Nonprofit												
33	Classroom												
34	Regular												
35	Controlled Circulation												
36	Transient												
37	Total Periodicals	7953.7	2680.0		7889.0	7269.5	2489.8			7271.4	7237.3	0.47%	34.1

Figure 10: Quantity Calculation – Packages, International & Other Mail Classes

Weighted Mail Volume													
		A	B	C	D	E	F	G	H	I	J	K	L
		Previous Year - 2009				Current Year - 2010							
Mail Class	Mail Product	Pieces	Attributable Cost	% Cost (Dollars)	Published Quantity	Pieces	Attributable Cost	% Cost (Dollars)	Catetory Index	Calculated Quantity	Published Quantity	% Published	+/- Published
38	Parcel Post												
39	Single-Piece Parcel Post	80.7	761.3	44.2%		61.5	748.9	44.4%	0.887				
40	Bound Printed Matter												
41	BPM Flats	238.8	118.8	6.9%		229.8	129.4	7.7%	0.997				
42	BPM Parcels	270.6	371.2	21.5%		244.7	349.2	20.7%	0.979				
43	Special Mail												
44	Library Mail												
45	Media Mail (Incl Library)												
46	Media & Library Mail	140.1	472.4	27.4%		122.5	458.6	27.2%	0.964				
47	Package Services	730.3	1723.7		749.2	658.5	1686.0			625.1	624.6	0.07%	0.5
48	Surface Letters & Cards	Methodology up to 2007											
49	Airmail Letters & Cards												
50	Airmail Other (incl Express)												
51	Economy Letter-Post												
52	Airmail Letter-Post (w/ Expr)												
53	Economy Periodicals												
54	Economy Parcel-Post												
55	Airmail Parcel-Post												
56	ISAL and Other Mail												
57	IPA												
58	International Mail First Class Mail												
59	Priority Mail												
60	Express Mail												
61	Total International												
62	USPS Mail												
63	Other Mail Free Mail												
64	Mailgrams												
65	Agency Penalty												
66	Franked												
67	Total International & Other Mail												
68	Expedited Services	5.5				5.8			1.008				
69	Outbound Priority Mail	23.6				23.7			1.001				
70	International Priority Airmail (IPA)	7.6				5.1			0.998				
71	Surface Airlift (ISAL)	3.5				2.4			0.999				
72	Direct Sacks M-Bags	0.1				0.1			0.998				
73	NSA Mail	261.2				233.0			0.978				
74	Letter Post												
75	Inbound Surface & Air PP												
76	International Market Dominant NSA												
77	Competitive NSA Mail												
78	Total International	301.5	919.8		361.8	270.0	908.3			355.7	355.7	0.00%	0.0
79	USPS Mail	454.9	543.0		454.9	432.0	462.3			432.0	432.0	0.00%	0.0
80	Other Mail Free Mail	62.0	54.2		62.0	67.3	66.3			67.3	67.3	0.00%	0.0
81	First-Class Package Service												
82	Parcel Select	222.9				268.4				268.4		0.00%	0.0
83	Parcel Return Service	18.3				28.5				28.5		0.00%	0.0

Figure 11: Flow Chart - Quantity Calculation for First Class Mail

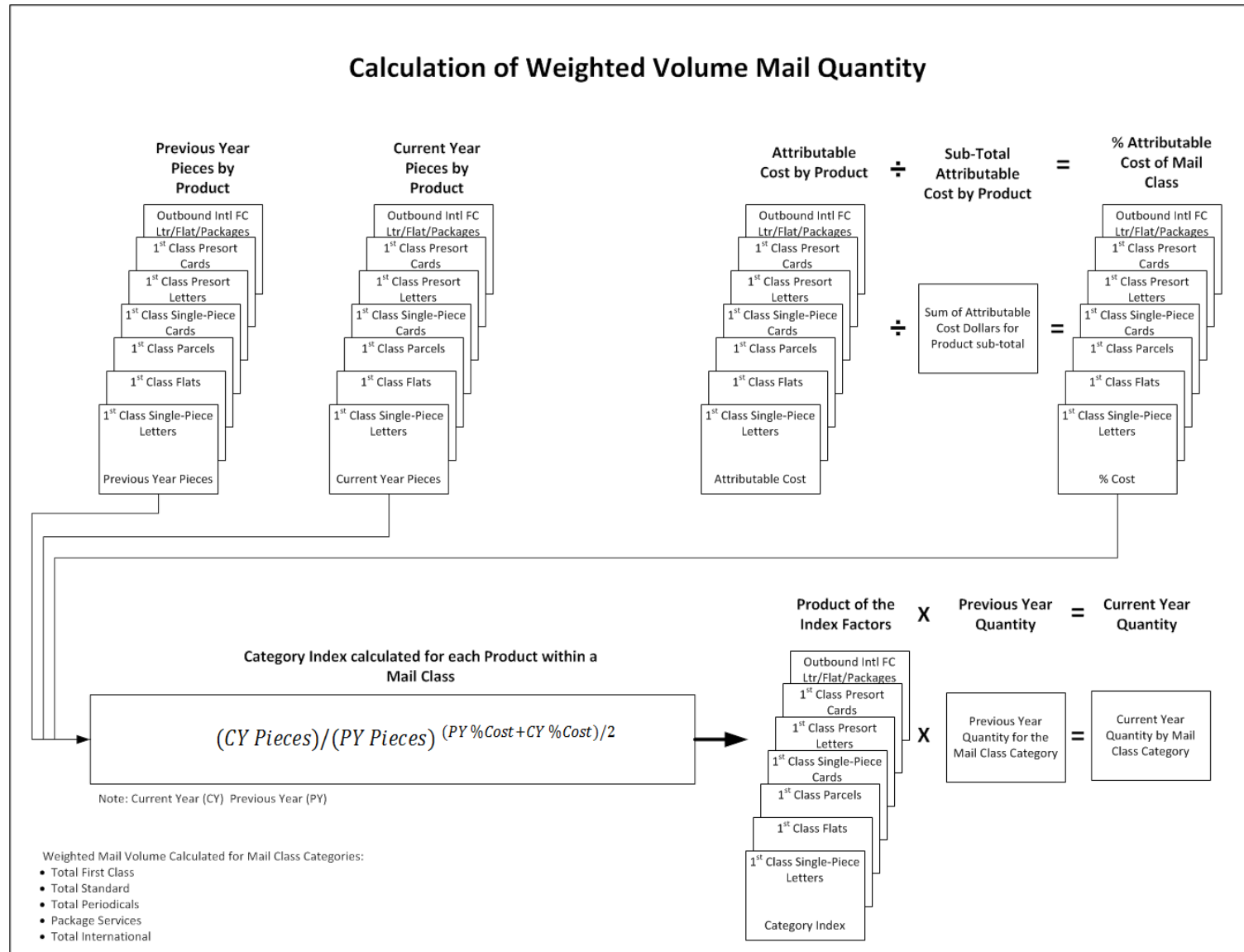


Figure 12: Calculation of Aggregate Weighted Mail Volume Quantity

Weighted Mail Volume													
		A	B	C	D	E	F	G	H	I	J	K	L
		Previous Year - 2009				Current Year - 2010							
Mail Class	Mail Product	Pieces	Attributable Cost	% Cost (Dollars)	Published Quantity	Pieces	Attributable Cost	% Cost (Dollars)	Catetory Index	Calculated Quantity	Published Quantity	% Published	+/- Published
Calculation of Output - Weighted Mail Volume						Using Published Quantity							
84	First Class		17766.3	43.5%	83262.2		16930.7	42.9%	0.963	76220.0			
85	Priority Mail		4078.9	10.0%	790.1		4203.4	10.7%	1.003	810.8			
86	Express Mail		553.3	1.4%	47.0		495.6	1.3%	0.999	42.6			
87	Standard Mail		12168.4	29.8%	81538.4		11818.4	30.0%	0.993	79578.1			
88	Periodicals		2680.0	6.6%	7889.0		2489.8	6.3%	0.994	7237.3			
89	Package Services		1723.7	4.2%	749.2		1686.0	4.3%	0.992	624.6			
90	International		919.8	2.2%	361.8		908.3	2.3%	1.000	355.7			
91	USPS Mail		543.0	1.3%	454.9		462.3	1.2%	0.999	432.0			
92	Free Mail		54.2	0.1%	62.0		66.3	0.2%	1.000	67.3			
93	First-Class Package Service			0.0%				0.0%					
94	Parcel Select								1.002				
95	Parcel Return Service								1.000				
96	Total Labor		40884.1	100.0%	177797.6		39442.7	100.0%		168073.4	168052.3	0.01%	21.0

Priority Mail

1. Columns A and E show the Pieces for Priority Mail.
2. The Quantity for Priority Mail equals the number of pieces. This is reflected in Column I.
3. The Attributable Cost data and the Previous Year Quantity are not shown here as they are not used in calculating the Current Year Quantity.

Express Mail

Express Mail follows the same methodology as Priority Mail.

Standard Mail, Periodicals, & Package Services

Standard Mail, Periodicals, and Package Services follow the methodology as explained for First Class Mail.

International Mail

International Mail follows the methodology as explained for First Class Mail. The categories for International Mail have shown a significant number of changes over the years. A major restructuring was done in 2008.

Other Mail

Quantity results are calculated for USPS Mail, Free Mail, First Class Package Services, Parcel Select, and Parcel Return Service. In 2010, these were calculated and published in the TFP reports. These were aggregated in the published reports starting in 2013.

F. Aggregate Weighted Mail Volume Quantity

The Aggregate Weighted Mail Volume Quantity is calculated using the quantities calculated for each of the Mail Class components. It is weighted using the Attributable Cost in the Tornqvist Index methodology.

G. Miscellaneous Output

Miscellaneous Output is comprised of all the non-mail volume components of Workload that should be included in a comprehensive productivity measurement. It has the following categories:

1. Market Dominant Ancillary Services

This category is predominately Certified Mail and USPS Tracking. Other services such as Registered Mail and Return Receipts are also included here.

2. Market Dominant Special Services

Post Office Boxes are included here. The workload of Post Office Boxes is accounted for in this category. (The TFP tables do not reflect category changes after PAEA.)

3. Competitive Services

These are Competitive International Ancillary Services, Premium Forwarding Service, and International Money Transfer Service.

4. Other Services

This represents Military Reimbursements and Other Miscellaneous services.

These categories are combined into an Aggregate Miscellaneous Output Quantity.

Figure 13: Calculation of Miscellaneous Output

Calculation of Miscellaneous Output																
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
		Previous Year - 2009					Current Year - 2010									
		Pieces	Apportioned Cost	% Cost (Dollars)	Unit Cost	Published Quantity	Pieces	Apportioned Cost	% Cost (Dollars)	Unit Cost	Published Quantity	Catetory Index	Calculated Quantity	% Published	+/- Published	
Marked Dominant Ancillary Services																
1	Certified Mail	266.5	659.5	45.7%	2.47		269.3	634.7	46.3%	2.36						
2	COD	1.0	6.6	0.5%	6.50		0.8	8.2	0.6%	9.89						
3	USPS Tracking	1062.9	488.6	33.9%	0.46		1371.1	491.5	35.9%	0.36						
4	Insurance	43.8	116.9	8.1%	2.67		39.1	98.6	7.2%	2.52						
5	Registered Mail	3.2	50.6	3.5%	15.90		3.0	42.6	3.1%	14.35						
6	Return Receipts	220.3	101.2	7.0%	0.46		215.6	77.3	5.6%	0.36						
7	Other Domestic Ancillary Services	18.5	8.5	0.6%	0.46		19.2	6.9	0.5%	0.36						
8	MD International Ancillary Services	1.7	3.8	0.3%	2.20		2.0	7.2	0.5%	3.59						
9	Stamped Envelopes		6.0	0.4%				2.8	0.2%							
10	Special Delivery															
11	Sub-Total Ancillary Services	1617.9	1441.7				1920.2	1369.8								
Market Dominant Special Services																
12	Money Orders	135.0	146.1		1.08		123.4	126.3		1.02						
13	Post Office Boxes															
Competitive Services																
14	Competitive International Ancillary Services	1.6					1.2									
15	Premium Forwarding Service	1.2					1.2									
16	Intl Money Transfer Service	0.3					0.2									
Market Dominant & Competitive Services																
17	Market Dominant & Competitive Sub-Total	1756.0	2241.6	62.9%	1.074	2087.5	2046.2	2198.7	62.6%	1.013	2168.5	1.024				
Other Services																
18	Military Reimbursements		513.4	14.4%	1.000	513.4		463.7	13.2%	0.970	478.2	0.990				
19	Other Miscellaneous		811.1	22.7%	1.015	799.2		852.3	24.2%	1.037	822.2	1.007				
Total Miscellaneous Output																
20	Total Miscellaneous Output		3566.1	100.0%	1.049	3400.0		3514.7	100.0%	1.012	3470.8		3471.3	0.01%	0.4	

H. Final Index Result Calculations

The process used to calculate the final TFP result is shown in the following Excel tables and process flow charts.

Total Output, Network, and Workload

Total Output is the result of combining Weighted Mail Volume and Miscellaneous Output. Network is the output represented by Possible Deliveries. Workload is the result of combining Total Output and Network into a final output result. Workload is the final output result used in the numerator of the TFP calculation.

Total Factor Productivity Index Calculation

The Labor, Capital, and Material Quantities are combined into a single Input result using the current year Value weighting. TFP is calculated by dividing the Workload by the Input.

Labor Productivity Index Calculation

The Labor Productivity Index is calculated by dividing the Workload by the Labor Input.

Postal Inflation Index

The Postal Inflation Index is the Value of the Resource Usage divided by the Workload. The Value of the Resource Usage is the sum of the Labor, Capital, and Materials Value result.

Figure 14: Calculation of Final Workload

Calculation of Final Workload Index Value						
	A	B	C	D	E	F
Combining Weighted Mail Volume & Miscellaneous Output into Total Output Index						
Total Output Index	1963	1972	2008	2009	2010	Index Factor
1 Total Pieces	67852.7	87156.1		177056.4	170618.0	
2 2008 Adjustment Factor			1.711			
3 Quantity Weighted Volume	67852.7	82606.9	141299.9	177797.6	168052.3	
4 Miscellaneous Output				3400.0	3470.8	
5 Index Weighted Volume				1.258	1.189	0.950
6 Miscellaneous Output				1.296	1.323	1.002
7 Cost Share Weighted Volume				92.2%	91.9%	
8 Miscellaneous Output				7.8%	8.1%	
9 Total Output Index Published Value				1.270	1.208	
10 Calculated Index					1.208	
Calculating Network (Possible Deliveries) Index						
Network Index	1963	1972	Adjustment Factors	2009	2010	
11 City	46.7	57.4		87.5	87.8	
12 Possible Deliveries Rural	9.0	11.3		39.4	39.9	
13 HCR				2.6	2.7	
14 Total PD	55.7	68.7		129.5	130.4	
15 2004 Adjusted Base			69.9			
16 Network Index Published Value				1.853	1.866	
17 Calculated Index				1.853	1.866	
Combining Total Output & Network (Possible Deliveries) Output into Final Workload Result						
Workload Index				2009	2010	Index Factor
18 Total Output Index				1.270	1.208	70.00%
19 Network Index				1.853	1.866	30.00%
19 Workload Index Published				1.412	1.366	
20 Calculated					1.366	

Figure 15: Calculation of Total Output, Network, & Workload

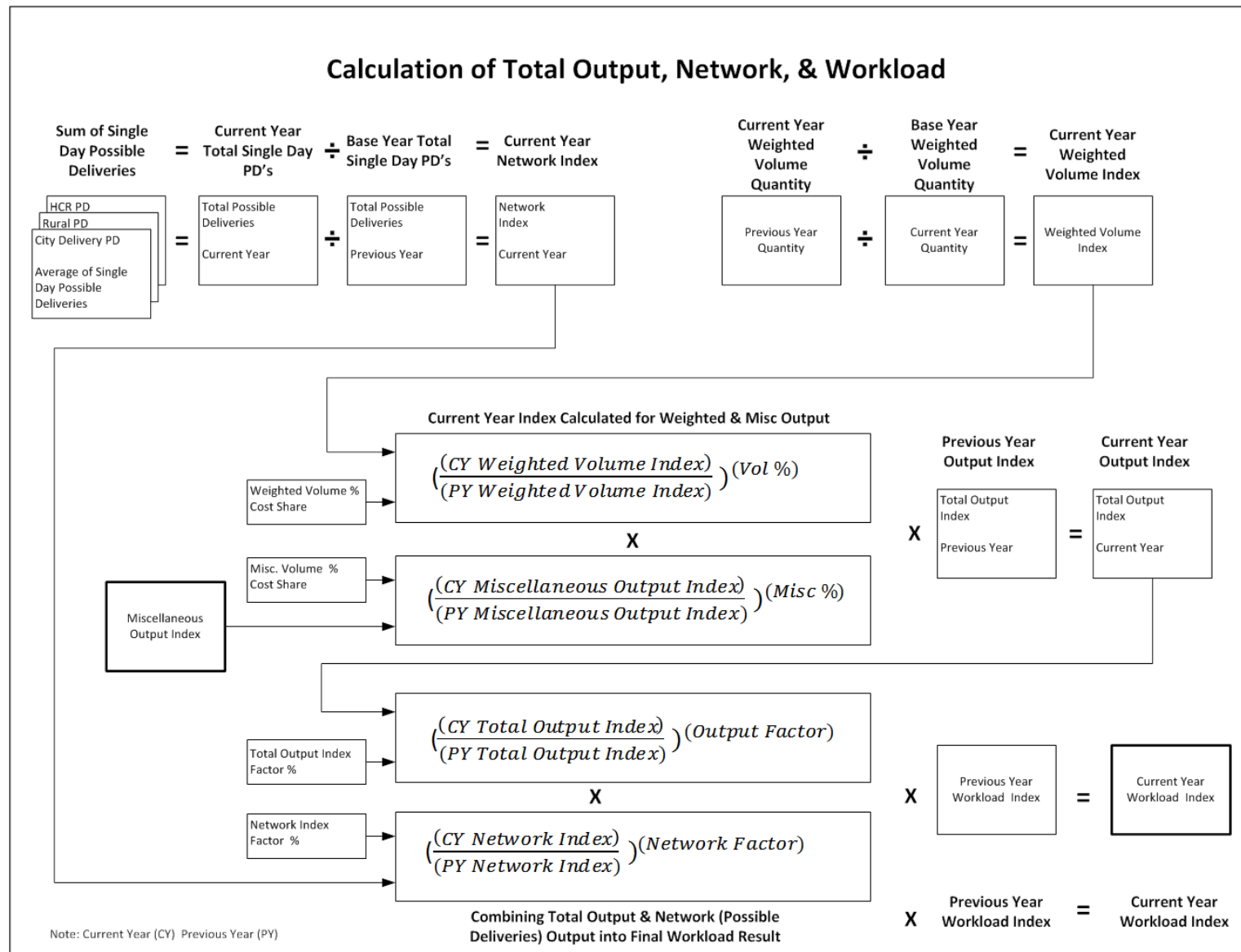
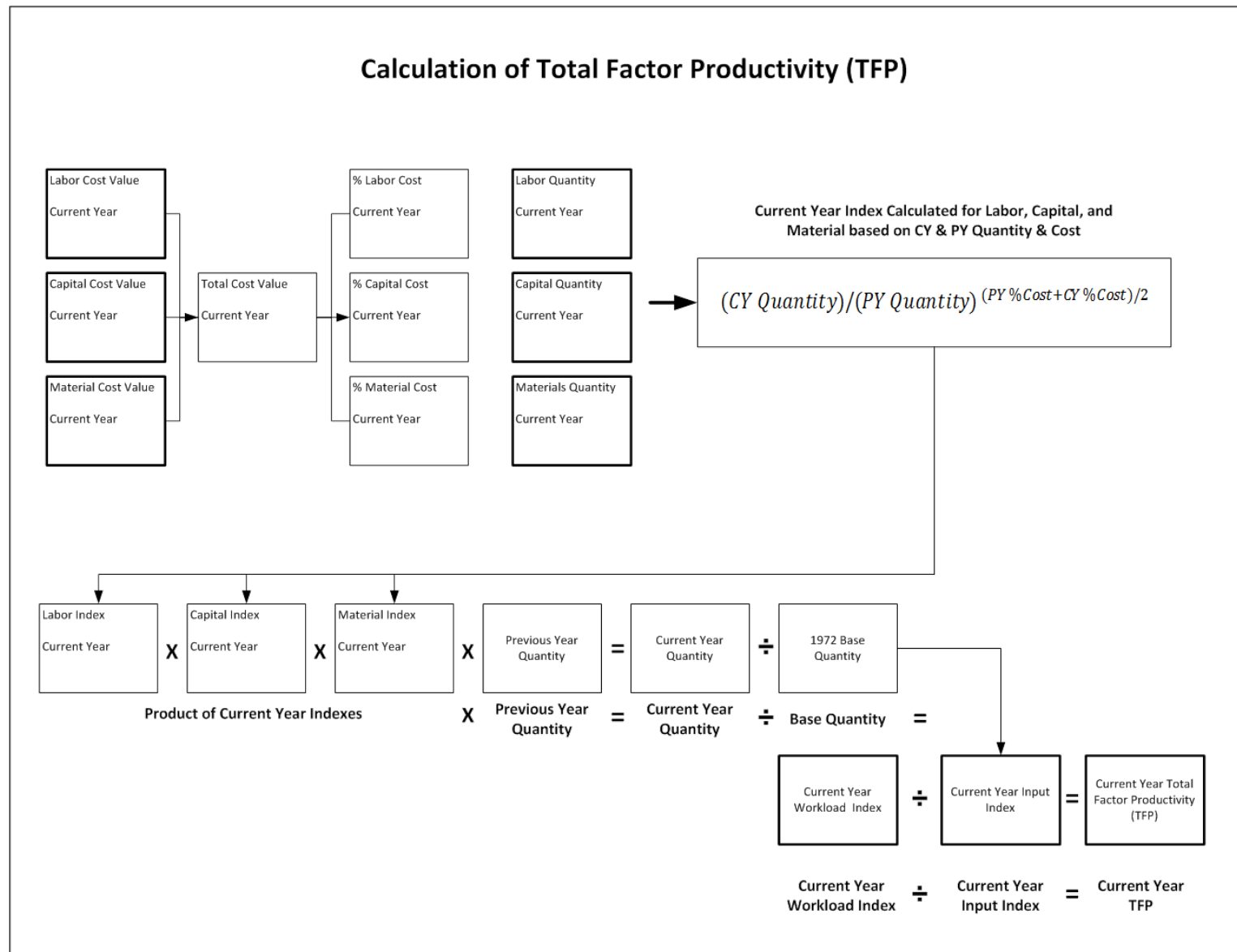


Figure 16: Calculation of Results Indexes – Total Factor Productivity, Labor Productivity, & Postal Inflation Indexes

Calculation of Postal Inflation, Labor Productivity, and Total Factor Productivity											
	A	B	C	D	E	F	G	H	I	J	
	1972	2009				2010					
	Quantity	(Cost) Value	% Cost	Quantity	TFP Input	(Cost) Value	% Cost (Dollars)	Quantity	Index	TFP Input	
Calculation of Input Index											
1	Labor	8041.4	56449.0	77.1%	7829.0		54240.5	76.3%	7388.1	0.957	
2	Input Index Caplial		4444.6	6.1%	1570.8		4829.0	6.8%	1535.5	0.999	
3	Materials		12354.2	16.9%	2868.4		11984.1	16.9%	2742.5	0.992	
4	Total	9681.4	73247.8		11550.7		71053.5		10949.1		
5	Input Index	1.000			1.193					1.131	
Calculation of Postal Inflation Index											
	1972	2009	2010	Growth Rate	% SPLY						
6	Value of Resource Usage	9681.4	73247.8	71053.5	-3.04						-3.00
7	Quantity of Workload	9681.4	13669.5	13224.7	-3.31						-3.25
8	Postal Inflation Index Calculated	1.000	5.358	5.373							
9	Published		5.361	5.375	0.27						0.27
10	% Published		-0.040%	-0.040%							
Calculation of Labor Productivity Index											
	1972	2009	2010	Growth Rate	% SPLY						
11	Workload Index	1.000	1.412	1.366	-3.31						-3.25
12	Labor Quantity	8041.4	7829.0	7388.1							
13	Labor Index	1.000	0.974	0.919	-5.80						-5.63
14	Labor Productivity Index	1.000	1.450	1.487	2.49						2.52
Calculation of Total Factor Productivity											
	1972	2009	2010	Growth Rate	% SPLY						
15	Workload Index	1.000	1.412	1.366	-3.31						-3.25
16	Input Index	1.000	1.193	1.131	-5.35						-5.21
17	Total Factor Productivity	1.000	1.183	1.208	2.04	2.06					

Figure 17: Calculation of TFP



III. TFP Results – 2016

1. Published Results

TFP is published each year through the PRC. It is published as an Excel file that contains a series of report tables showing the data used and the results of the TFP model. The Excel file does not contain any formulas, only the values. This report is generated by Christensen Associates.

TFP is first provided at the end of December as a preliminary result for the year. The result is preliminary because the Attributable Costs are estimated using the cost per piece from the previous year, multiplied by the current year's pieces. The final report is published later in the year when the final Attributable Costs are available. The data in this section are the final 2016 Results.

The report tables are organized in different periods of years, usually grouped around major restructuring or reporting changes. NWPC reorganized the data and results in these reports to create a usable data set for analysis and model development.

These reports are presented as Appendix 1 – Published TFP Data and Results. This is the source of the graphs and reports provided in this section.

The graphs and specific data used in them are provided in Appendix 6 – Graphs Used in the Reports.

The TFP results are shown in Figure 18: Total Factor Productivity.

- TPF is the Workload divided by the Input.
- Input is based on the Labor, Capital, and Materials categories.
- The Workload is based on the Weighted Mail Volume, Miscellaneous Output, and Possible Deliveries (Network).
- The resulting TFP is shown as an Index value with 1972 as the base year equal to one (1.00).
- Workload reflects the impacts of volume reductions, worksharing, electronic diversion, possible deliveries and ecommerce growth.
- This reflects the end result of the TFP methodology.

Figure 18: Total Factor Productivity

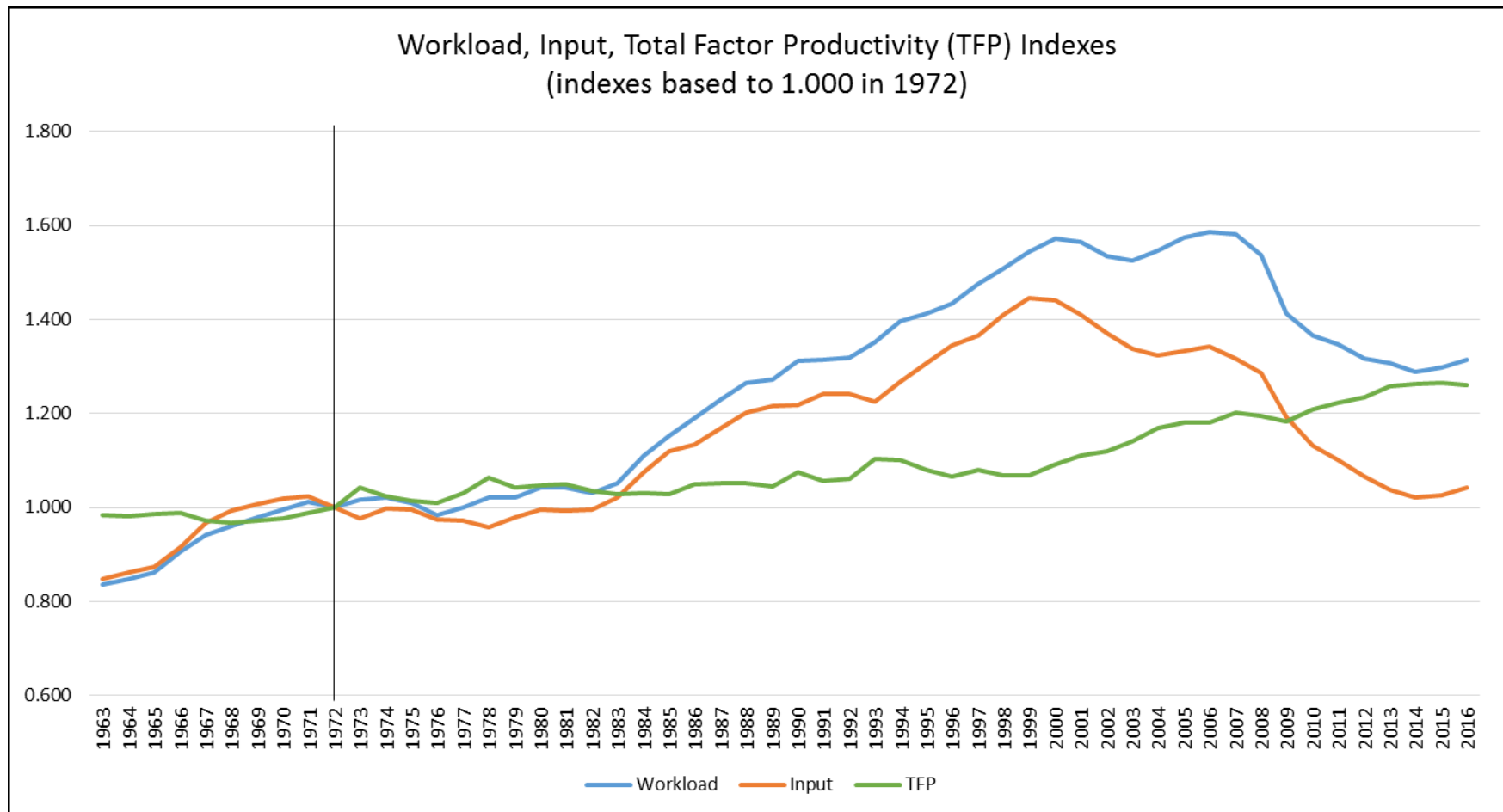
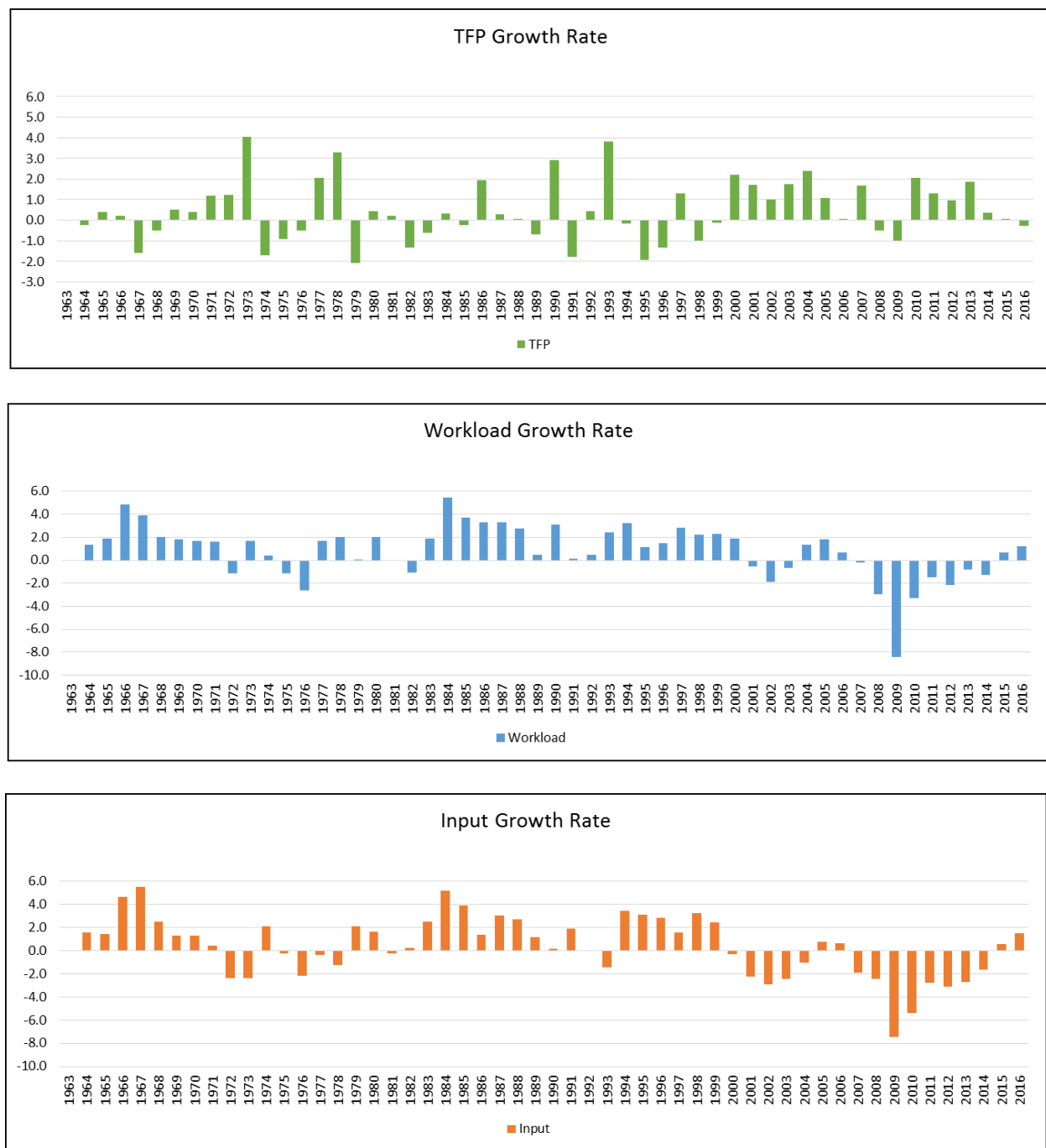


Figure 19: Total Factor Productivity – Growth Rates for TFP, Workload, & Input



- Figure 19 shows the Growth Rate for TFP, Workload, and Input.
- The Growth Rate is calculated using a logarithm formula.
- The table of actual values follows as Figure 20.
- While the TFP in the top chart reflects the differences in the change in inputs and workload, it is worth noting how closely the input growth trends track the workload growth trends.

Figure 20: Published Result – TFP 2016 with 2015 CRA

Workload, Input and Total Factor Productivity (TFP) Indexes (indexes based to 1.0 in 1972)						
Year	Total Factor Productivity			Growth Rates (%)		
	Workload	Input	TFP	Workload	Input	TFP
1963	0.836	0.848	0.985			
1964	0.847	0.862	0.982	1.32	1.56	-0.24
1965	0.863	0.875	0.986	1.86	1.47	0.39
1966	0.905	0.916	0.988	4.85	4.65	0.19
1967	0.942	0.968	0.972	3.92	5.52	-1.60
1968	0.961	0.993	0.968	2.03	2.53	-0.51
1969	0.979	1.006	0.973	1.83	1.31	0.52
1970	0.995	1.019	0.976	1.69	1.31	0.38
1971	1.012	1.024	0.988	1.63	0.44	1.20
1972	1.000	1.000	1.000	-1.16	-2.36	1.20
1973	1.017	0.976	1.041	1.66	-2.38	4.04
1974	1.021	0.998	1.024	0.44	2.15	-1.71
1975	1.009	0.995	1.014	-1.17	-0.23	-0.93
1976	0.983	0.974	1.009	-2.64	-2.14	-0.50
1977	1.000	0.971	1.030	1.71	-0.33	2.04
1978	1.021	0.959	1.064	2.05	-1.26	3.30
1979	1.021	0.980	1.042	0.05	2.14	-2.09
1980	1.042	0.996	1.047	2.04	1.62	0.42
1981	1.042	0.993	1.049	-0.03	-0.23	0.20
1982	1.031	0.996	1.035	-1.06	0.27	-1.33
1983	1.051	1.022	1.029	1.91	2.52	-0.61
1984	1.110	1.076	1.032	5.48	5.17	0.30
1985	1.152	1.119	1.029	3.72	3.95	-0.23
1986	1.191	1.135	1.050	3.31	1.37	1.94
1987	1.231	1.169	1.052	3.29	3.02	0.27
1988	1.266	1.202	1.053	2.79	2.75	0.05
1989	1.272	1.216	1.046	0.50	1.20	-0.69
1990	1.312	1.219	1.076	3.08	0.19	2.90
1991	1.314	1.243	1.057	0.16	1.94	-1.77
1992	1.320	1.243	1.062	0.45	0.02	0.43
1993	1.352	1.225	1.103	2.39	-1.44	3.83
1994	1.396	1.268	1.101	3.24	3.42	-0.18
1995	1.413	1.308	1.080	1.16	3.10	-1.95
1996	1.434	1.345	1.066	1.50	2.83	-1.33
1997	1.475	1.366	1.080	2.84	1.56	1.28
1998	1.509	1.412	1.069	2.25	3.26	-1.01
1999	1.544	1.447	1.067	2.31	2.45	-0.14
2000	1.573	1.442	1.091	1.87	-0.32	2.19
2001	1.565	1.410	1.110	-0.53	-2.24	1.71
2002	1.535	1.370	1.121	-1.89	-2.87	0.98
2003	1.525	1.337	1.141	-0.65	-2.41	1.75
2004	1.546	1.324	1.168	1.36	-1.04	2.40
2005	1.575	1.333	1.181	1.81	0.75	1.06
2006	1.586	1.342	1.182	0.70	0.65	0.06
2007	1.582	1.317	1.202	-0.22	-1.90	1.68
2008	1.536	1.285	1.195	-2.96	-2.44	-0.52
2009	1.412	1.193	1.183	-8.43	-7.43	-1.00
2010	1.366	1.131	1.208	-3.31	-5.35	2.04
2011	1.346	1.100	1.224	-1.46	-2.77	1.31
2012	1.317	1.066	1.236	-2.16	-3.13	0.97
2013	1.307	1.038	1.259	-0.83	-2.68	1.85
2014	1.290	1.021	1.263	-1.31	-1.65	0.35
2015	1.298	1.027	1.264	0.66	0.61	0.06
2016	1.314	1.043	1.260	1.21	1.51	-0.30

Figure 21: Labor Productivity

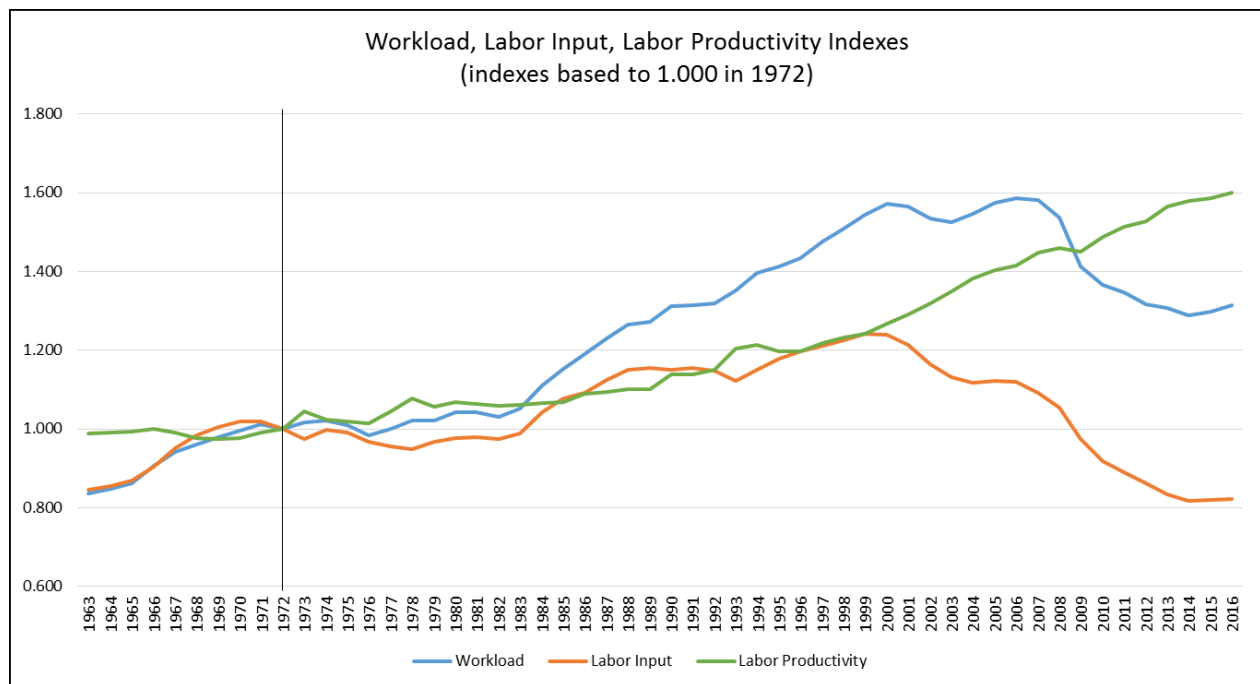
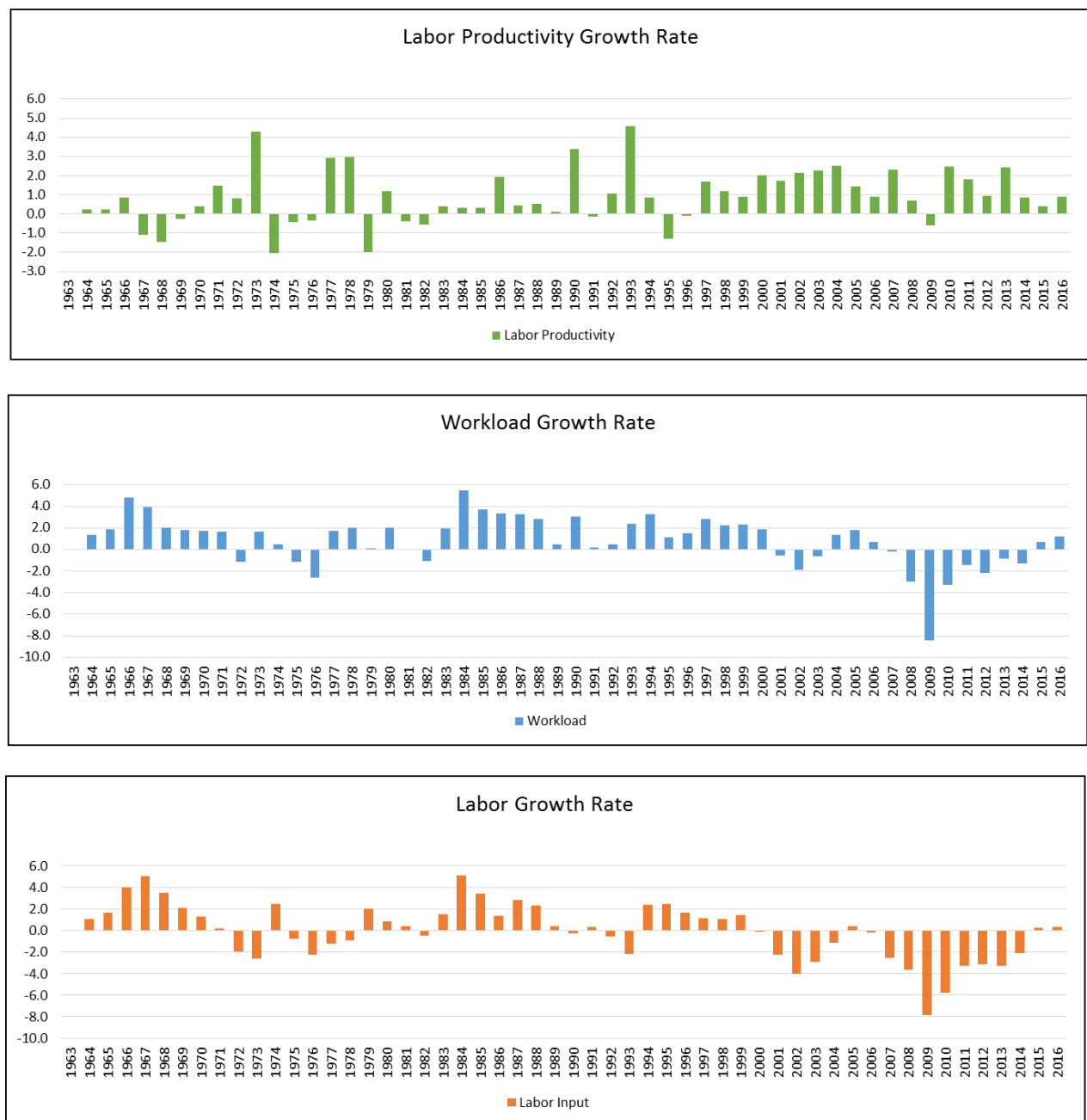


Figure 21 shows the Labor Productivity Index results.

- Though it does not account for all of the inputs, labor productivity is a classic measure of productivity.
- The beginning of the measure in 1963 through 2000 saw continuous but, for the most part, relatively modest gains in labor productivity.
- Workload began to flatten then subsequently drop around 2001.
- Mail volume growth was slowing.
- Increased workshare in the form of more presort, automation compatible mail, dropship and incentives to drive mail to lower-cost shapes reduced the workload content of the mail.
- The same 2001 period began an even sharper decline in the Labor Input.
- Coupled with a variety of cost saving programs focusing on automation and operations efficiency, the end result is that labor productivity saw much more rapid gains starting in that same 2001 time period.

Figure 22: Labor Productivity - Growth Rates for Index, Workload, & Input



- Starting in 1997, labor productivity has increased in almost every year.
- The labor growth rate has tended to reflect the workload growth rate but at a slightly lower rate resulting in labor productivity growth.
- It is worth noting there were more declines in labor than workload during the periods in the 70's and early 90's.
- Labor has grown in the past two years but at a smaller rate than workload.

Figure 23: Labor Productivity Index

Workload, Labor Input and Labor Productivity Indexes (indexes based to 1.0 in 1972)						
Year				Growth Rates (%)		
	Workload	Labor Input	Labor Productivity	Workload	Labor Input	Labor Productivity
1963	0.836	0.846	0.988			
1964	0.847	0.855	0.990	1.32	1.08	0.24
1965	0.863	0.869	0.993	1.86	1.63	0.23
1966	0.905	0.904	1.001	4.85	3.98	0.87
1967	0.942	0.951	0.991	3.92	5.00	-1.07
1968	0.961	0.984	0.976	2.03	3.50	-1.48
1969	0.979	1.005	0.973	1.83	2.10	-0.27
1970	0.995	1.018	0.977	1.69	1.28	0.41
1971	1.012	1.020	0.992	1.63	0.17	1.46
1972	1.000	1.000	1.000	-1.16	-1.98	0.82
1973	1.017	0.974	1.044	1.66	-2.65	4.31
1974	1.021	0.998	1.023	0.44	2.48	-2.04
1975	1.009	0.991	1.019	-1.17	-0.76	-0.41
1976	0.983	0.968	1.015	-2.64	-2.28	-0.36
1977	1.000	0.957	1.045	1.71	-1.21	2.92
1978	1.021	0.948	1.077	2.05	-0.94	2.99
1979	1.021	0.967	1.056	0.05	2.05	-2.00
1980	1.042	0.976	1.068	2.04	0.85	1.19
1981	1.042	0.979	1.064	-0.03	0.37	-0.40
1982	1.031	0.974	1.058	-1.06	-0.50	-0.56
1983	1.051	0.989	1.062	1.91	1.51	0.40
1984	1.110	1.041	1.066	5.48	5.14	0.34
1985	1.152	1.078	1.069	3.72	3.42	0.30
1986	1.191	1.093	1.090	3.31	1.38	1.93
1987	1.231	1.124	1.095	3.29	2.83	0.46
1988	1.266	1.150	1.101	2.79	2.28	0.51
1989	1.272	1.155	1.102	0.50	0.41	0.10
1990	1.312	1.151	1.139	3.08	-0.29	3.37
1991	1.314	1.155	1.138	0.16	0.30	-0.14
1992	1.320	1.148	1.150	0.45	-0.59	1.04
1993	1.352	1.123	1.203	2.39	-2.18	4.57
1994	1.396	1.151	1.214	3.24	2.40	0.84
1995	1.413	1.179	1.198	1.16	2.44	-1.28
1996	1.434	1.198	1.197	1.50	1.61	-0.11
1997	1.475	1.212	1.217	2.84	1.16	1.69
1998	1.509	1.225	1.232	2.25	1.05	1.20
1999	1.544	1.242	1.243	2.31	1.42	0.89
2000	1.573	1.240	1.268	1.87	-0.15	2.02
2001	1.565	1.213	1.290	-0.53	-2.27	1.73
2002	1.535	1.165	1.319	-1.89	-4.05	2.16
2003	1.525	1.131	1.349	-0.65	-2.92	2.27
2004	1.546	1.118	1.383	1.36	-1.14	2.50
2005	1.575	1.122	1.403	1.81	0.38	1.44
2006	1.586	1.120	1.416	0.70	-0.20	0.90
2007	1.582	1.092	1.449	-0.22	-2.53	2.31
2008	1.536	1.053	1.459	-2.96	-3.64	0.67
2009	1.412	0.974	1.450	-8.43	-7.86	-0.58
2010	1.366	0.919	1.487	-3.31	-5.80	2.49
2011	1.346	0.889	1.514	-1.46	-3.29	1.83
2012	1.317	0.862	1.529	-2.16	-3.11	0.95
2013	1.307	0.834	1.566	-0.83	-3.26	2.43
2014	1.290	0.816	1.579	-1.31	-2.14	0.84
2015	1.298	0.819	1.586	0.66	0.26	0.41
2016	1.314	0.821	1.600	1.21	0.34	0.88

Figure 24: Postal Inflation Index

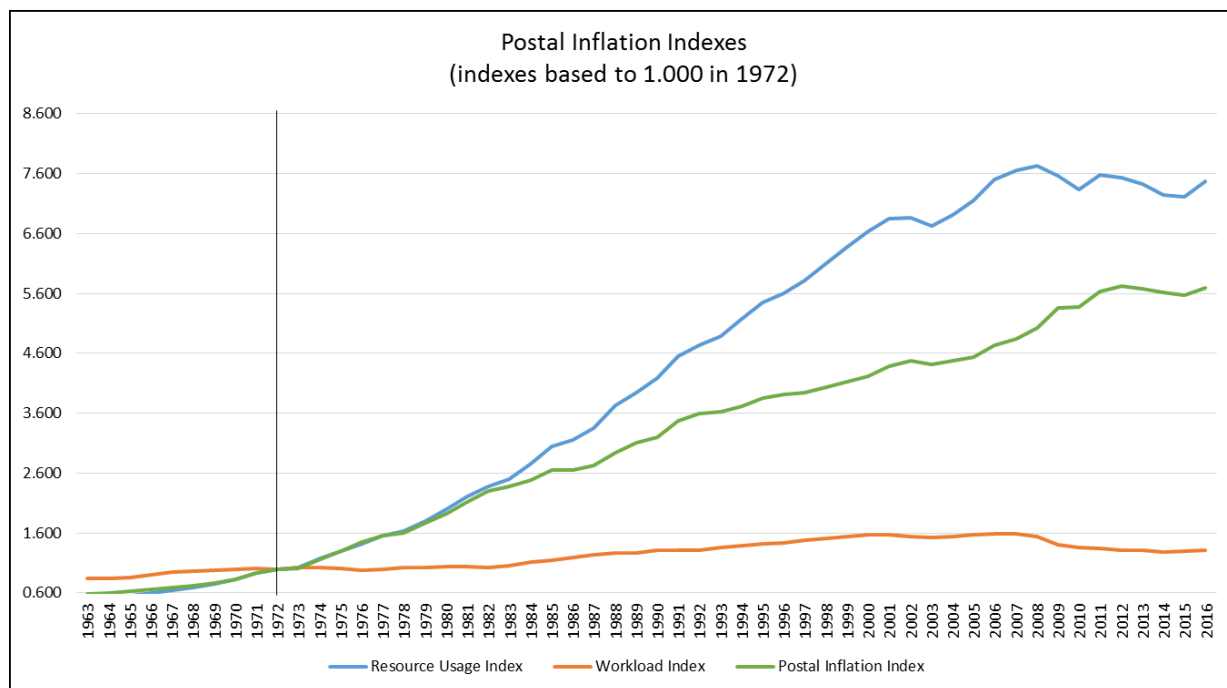
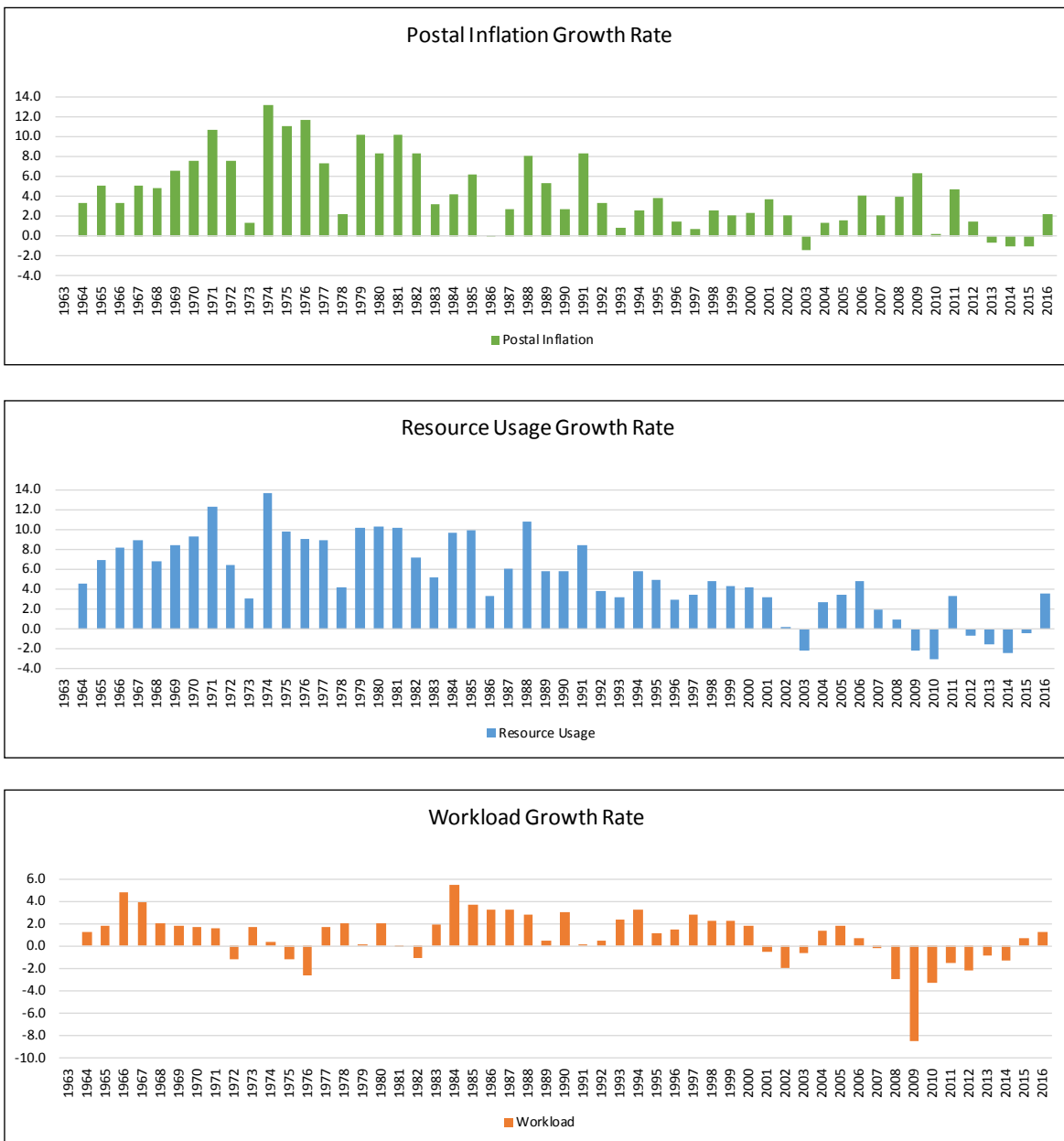


Figure 24 shows the Postal Inflation Index.

- The Postal Inflation Index is the Value of the Resource Usage divided by the Workload. The Value of the Resource Usage is the sum of the Labor, Capital, and Materials Value result.
- Effectively, it is the cost change that cannot be explained by the change in workload.
- Postal inflation increased relatively consistently from 1963 until 2008 when resource usage stabilized and postal inflation abated.
- Postal inflation has tended to reflect the growth in resource usage but in a more moderate manner reflecting the improvements in productivity.

Figure 25: Growth Rates for Postal Inflation Index



- Again, as shown in the top two charts, the growth in postal inflation has reflected the resource usage growth rate.
- Resource usage tends to track workload growth rates.
- However, the workload growth rate has shown smaller increases and larger declines than resource usage leading to generally positive postal inflation numbers until all but 2 of the past 8 years.

Figure 26: Postal Inflation Index

Value of Resource Usage, Quantity of Workload, and Postal Inflation Index (quantity based to millions of 1972 dollars, inflation index based to 1.0 in 1972)								
Year	Value of Resource Usage	Index of Resource Usage	Quantity of Workload	Workload Index	Postal Inflation Index	Growth Rates (%)		
						Value of Resource Usage	Quantity of Workload	Postal Inflation Index
1963	4716.6	0.487	8088.9	0.836	0.583			
1964	4939.7	0.510	8196.4	0.847	0.603	4.62	1.32	3.30
1965	5293.9	0.547	8350.3	0.863	0.634	6.92	1.86	5.06
1966	5743.3	0.593	8765.0	0.905	0.655	8.15	4.85	3.30
1967	6281.7	0.649	9115.8	0.942	0.689	8.96	3.92	5.04
1968	6726.9	0.695	9302.5	0.961	0.723	6.85	2.03	4.82
1969	7318.0	0.756	9474.4	0.979	0.772	8.42	1.83	6.59
1970	8028.0	0.829	9635.5	0.995	0.833	9.26	1.69	7.57
1971	9080.8	0.938	9794.2	1.012	0.927	12.32	1.63	10.69
1972	9681.4	1.000	9681.4	1.000	1.000	6.40	-1.16	7.56
1973	9979.6	1.031	9843.6	1.017	1.014	3.03	1.66	1.37
1974	11436.7	1.181	9886.9	1.021	1.157	13.63	0.44	13.19
1975	12621.6	1.304	9772.1	1.009	1.292	9.86	-1.17	11.03
1976	13814.0	1.427	9517.2	0.983	1.451	9.03	-2.64	11.67
1977	15109.8	1.561	9681.6	1.000	1.561	8.97	1.71	7.25
1978	15762.2	1.628	9882.0	1.021	1.595	4.23	2.05	2.18
1979	17451.1	1.803	9886.9	1.021	1.765	10.18	0.05	10.13
1980	19354.3	1.999	10090.3	1.042	1.918	10.35	2.04	8.31
1981	21422.6	2.213	10087.4	1.042	2.124	10.15	-0.03	10.18
1982	23030.9	2.379	9981.1	1.031	2.307	7.24	-1.06	8.30
1983	24253.6	2.505	10173.4	1.051	2.384	5.17	1.91	3.26
1984	26727.7	2.761	10746.0	1.110	2.487	9.71	5.48	4.24
1985	29521.4	3.049	11153.4	1.152	2.647	9.94	3.72	6.22
1986	30520.3	3.152	11528.7	1.191	2.647	3.33	3.31	0.02
1987	32411.3	3.348	11914.9	1.231	2.720	6.01	3.29	2.72
1988	36104.1	3.729	12252.4	1.266	2.947	10.79	2.79	8.00
1989	38256.8	3.952	12314.4	1.272	3.107	5.79	0.50	5.29
1990	40547.4	4.188	12699.9	1.312	3.193	5.81	3.08	2.73
1991	44128.1	4.558	12720.4	1.314	3.469	8.46	0.16	8.30
1992	45841.0	4.735	12778.2	1.320	3.587	3.81	0.45	3.36
1993	47348.6	4.891	13087.4	1.352	3.618	3.24	2.39	0.84
1994	50174.0	5.183	13518.6	1.396	3.711	5.80	3.24	2.55
1995	52704.9	5.444	13675.8	1.413	3.854	4.92	1.16	3.77
1996	54288.3	5.607	13882.2	1.434	3.911	2.96	1.50	1.46
1997	56225.8	5.808	14282.3	1.475	3.937	3.51	2.84	0.67
1998	59034.0	6.098	14606.7	1.509	4.042	4.87	2.25	2.63
1999	61680.7	6.371	14947.4	1.544	4.127	4.39	2.31	2.08
2000	64293.8	6.641	15229.7	1.573	4.222	4.15	1.87	2.28
2001	66374.9	6.856	15149.0	1.565	4.381	3.19	-0.53	3.72
2002	66503.3	6.869	14865.3	1.535	4.474	0.19	-1.89	2.08
2003	65128.1	6.727	14768.4	1.525	4.410	-2.09	-0.65	-1.44
2004	66920.9	6.912	14970.7	1.546	4.472	2.76	1.36	1.40
2005	69230.7	7.151	15244.6	1.575	4.543	3.39	1.81	1.58
2006	72651.1	7.504	15352.3	1.586	4.734	4.82	0.70	4.12
2007	74057.3	7.649	15319.2	1.582	4.836	1.92	-0.22	2.13
2008	74796.1	7.726	14872.4	1.536	5.031	0.99	-2.96	3.95
2009	73247.8	7.566	13669.5	1.412	5.361	-2.09	-8.43	6.34
2010	71053.5	7.339	13224.7	1.366	5.375	-3.04	-3.31	0.27
2011	73418.2	7.583	13033.0	1.346	5.636	3.27	-1.46	4.73
2012	72937.9	7.534	12754.8	1.317	5.721	-0.66	-2.16	1.50
2013	71853.6	7.422	12649.4	1.307	5.683	-1.50	-0.83	-0.67
2014	70172.0	7.248	12485.1	1.290	5.623	-2.37	-1.31	-1.06
2015	69910.7	7.221	12568.3	1.298	5.565	-0.37	0.66	-1.04
2016	72415.6	7.480	12721.8	1.314	5.695	3.52	1.21	2.31

Figure 27: Weighted Mail Volume, Miscellaneous Output combine for Total Output Index

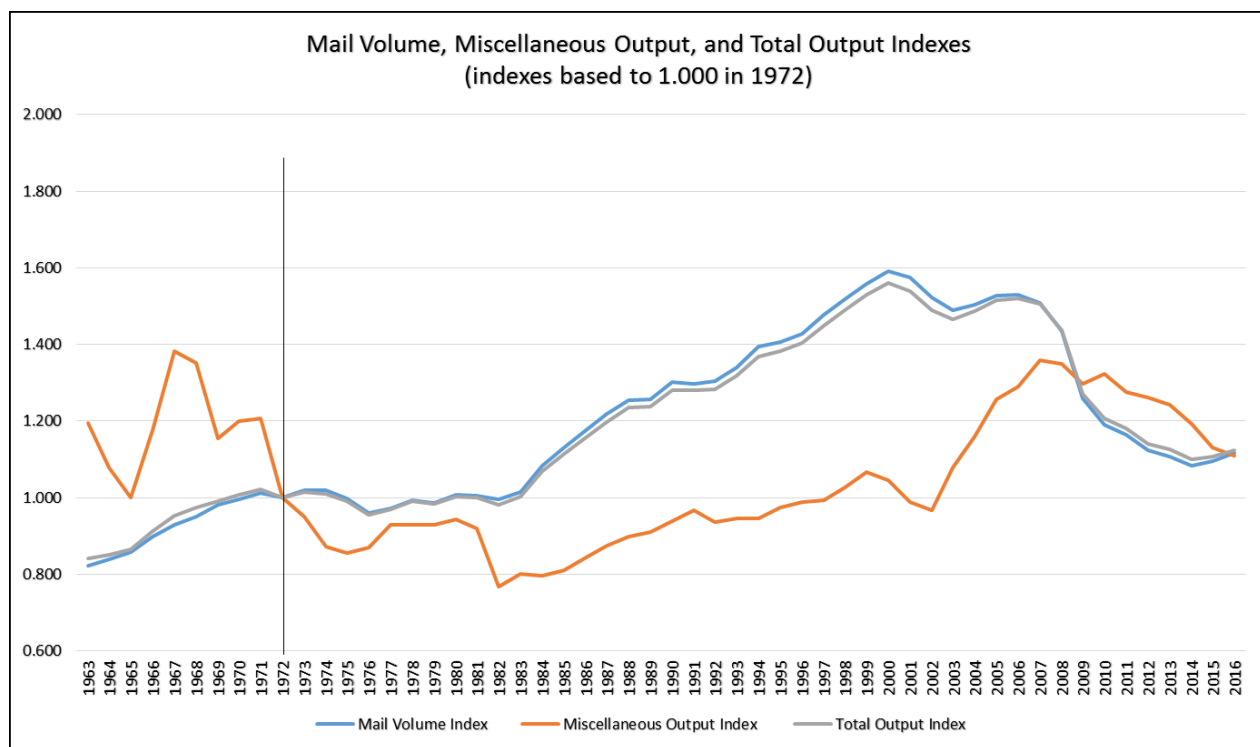
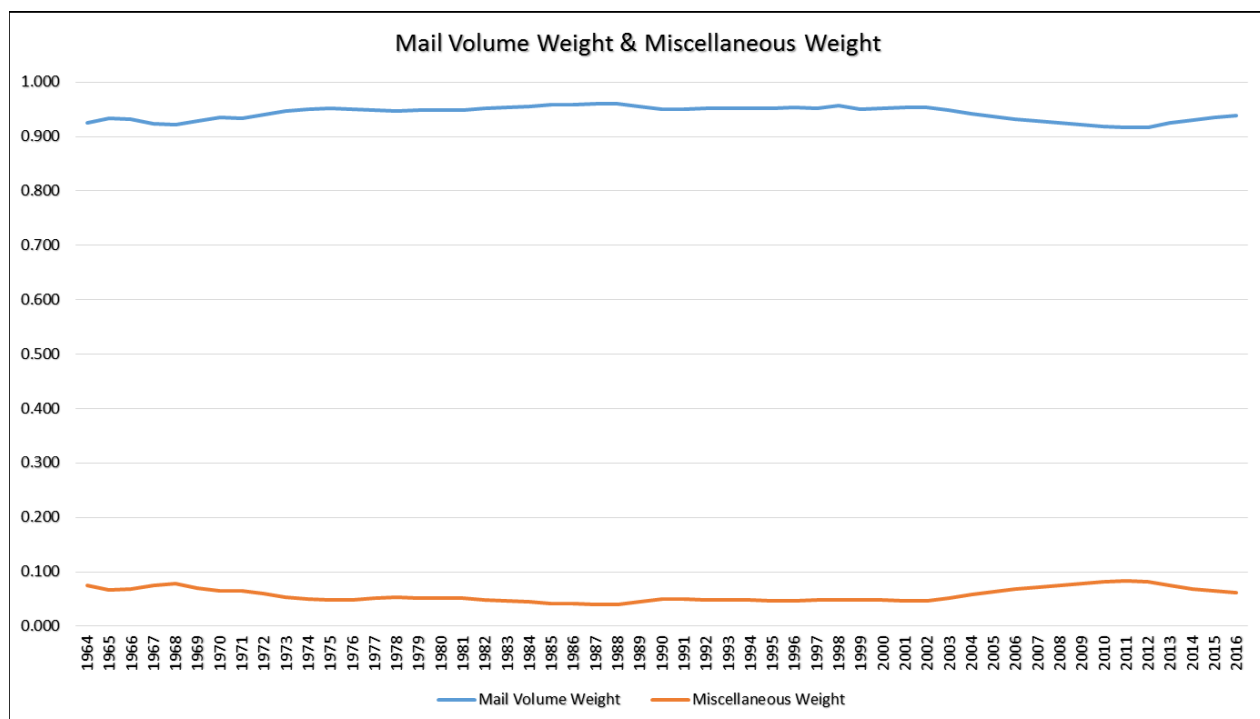
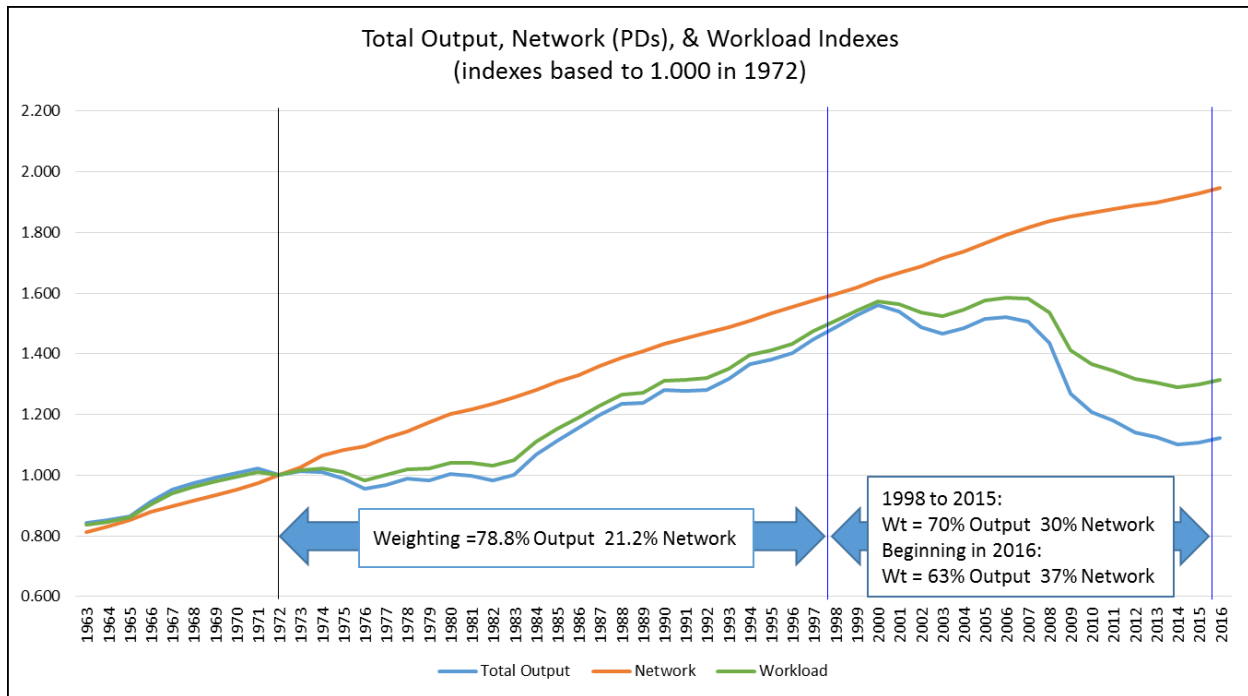


Figure 28: Mail Volume and Miscellaneous Output Weighting for Total Output



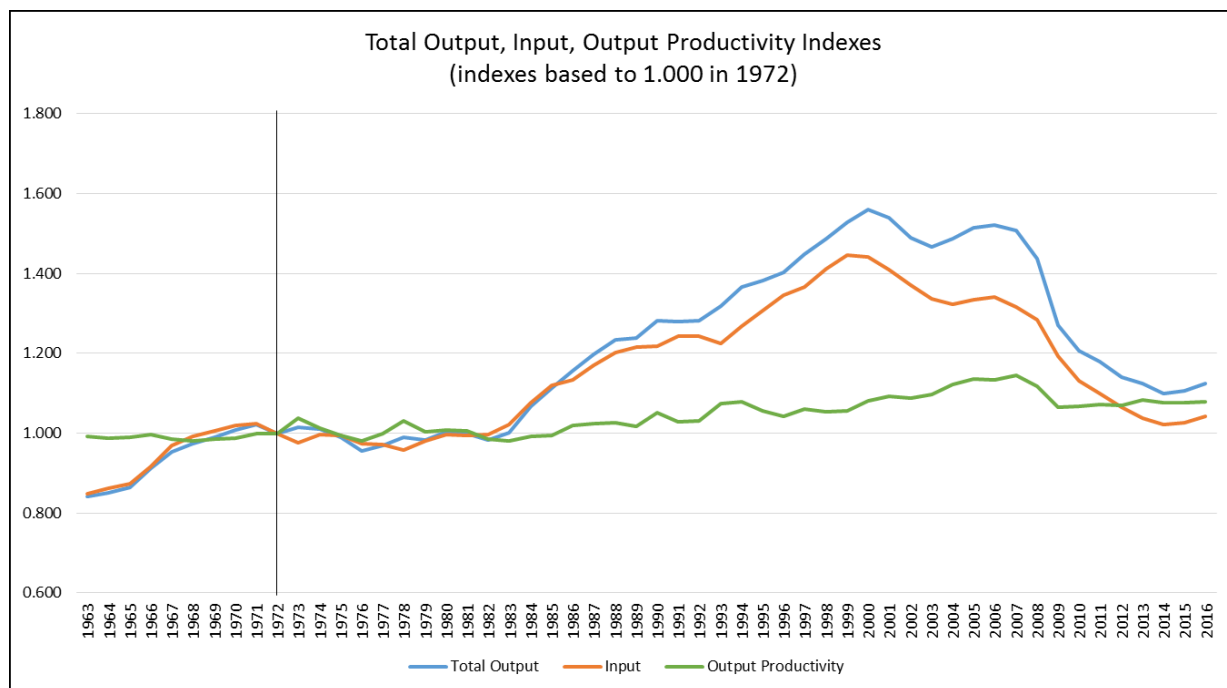
- These graphs show the relationship between the Weighted Mail Volume and Miscellaneous Output in combining for Total Output.

Figure 29: Total Output, Network, and Resulting Workload Indexes



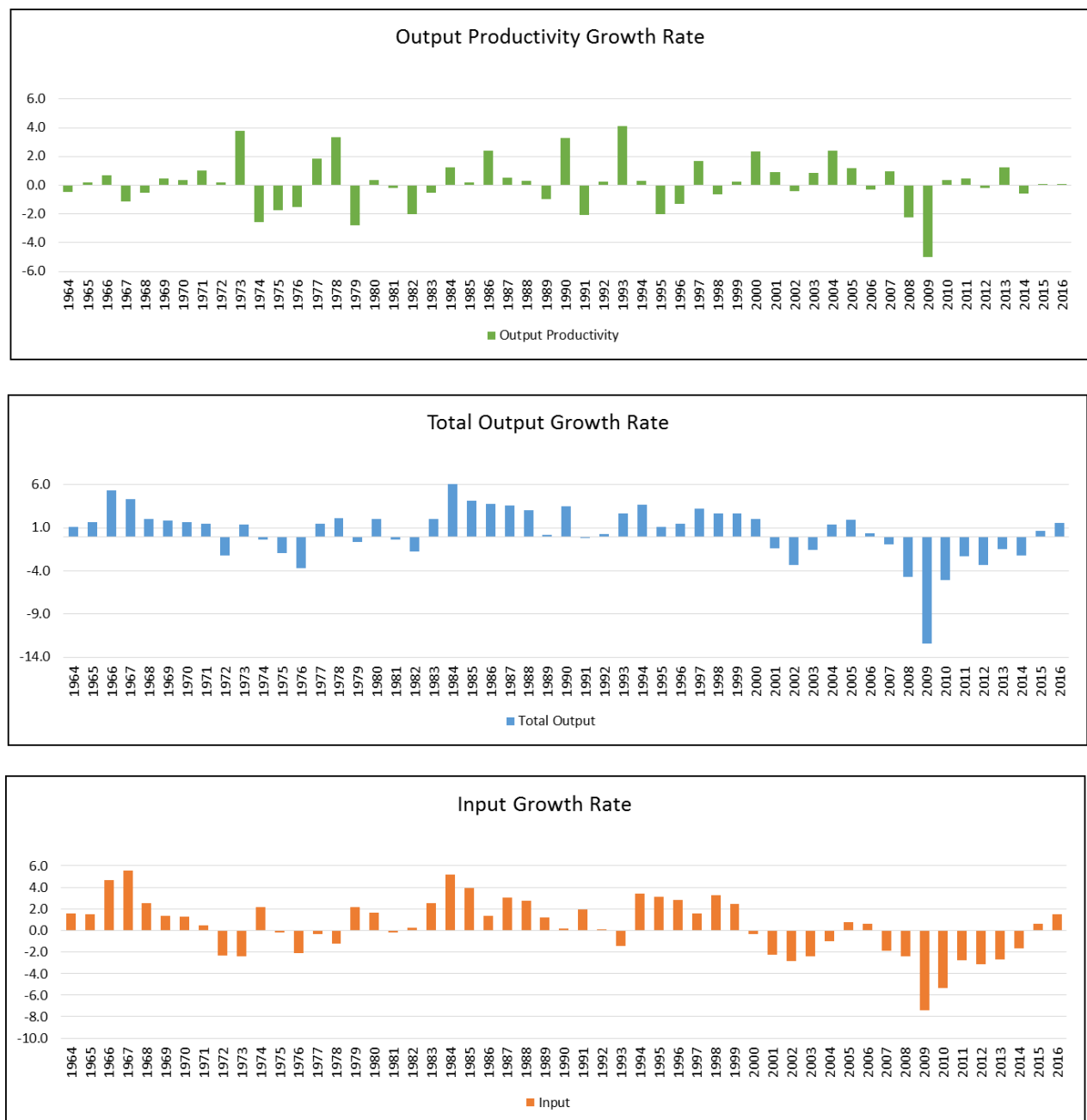
- Workload is the result of combining the Total Output with the Network (Possible Deliveries).
- Workload is the numerator in the TFP equation.
- The weighting was originally set at 78.8% for Total Output and 21.2% for Network. Christensen Associates monitors the weighting through a cost elasticity model. Based on their model's results, they changed the weighting to 70% / 30% in 1998. They began observing changes in this relationship again starting in 2009. When they were confident it had stabilized in 2016, the weighting was changed to 63% / 37%. This is explained in a memorandum from Christensen in Appendix 3 (TFP Methodology - Reference Documents).
- Total Output tended to track Workload (Weighted Mail Volume and Miscellaneous Output) until 2001.
- At that time, mail volume growth slowed and increased workshare began pulling down the workload index.
- That trend was exacerbated with the volume declines of the recession beginning in 2008.
- Once the Workload declined, the gradual growth in the Network (Possible Deliveries) began having a more discernible effect on Total Output by reducing the rate of the decline relative to the Network decline.

Figure 30: Total Output Productivity Index - Using Only Total Output (No Possible Deliveries)



- One way to look at productivity is to take the network out of the equation and focus on the output of Weighted Mail Volume and Miscellaneous Output.
- Input (labor, capital and materials) tended to track output very closely through 1986.
- At that time, the Postal Service was able to reduce input growth below output growth.
- In fact, the gap between input and output growth mostly increased until 2008 at the time when the recession dramatically reduced mail volume and therefore output.
- Since then, the Postal Service has still managed to maintain a smaller but substantial positive gap between input and output declines.

Figure 31: Growth Rates for Total Output Productivity Index



- As a bar graph, the top chart shows more positive than negative output productivity increases.
- The productivity growth chart shows declines in 2008 and 2009 where the Postal Service was unable to immediately match the large volume output declines with equal or greater reductions in inputs.
- The last two charts show output and input growth rates trend in a very similar manner suggesting that the Postal Service tends to match inputs with the output at hand.

Figure 32: Labor, Capital, & Material Quantities

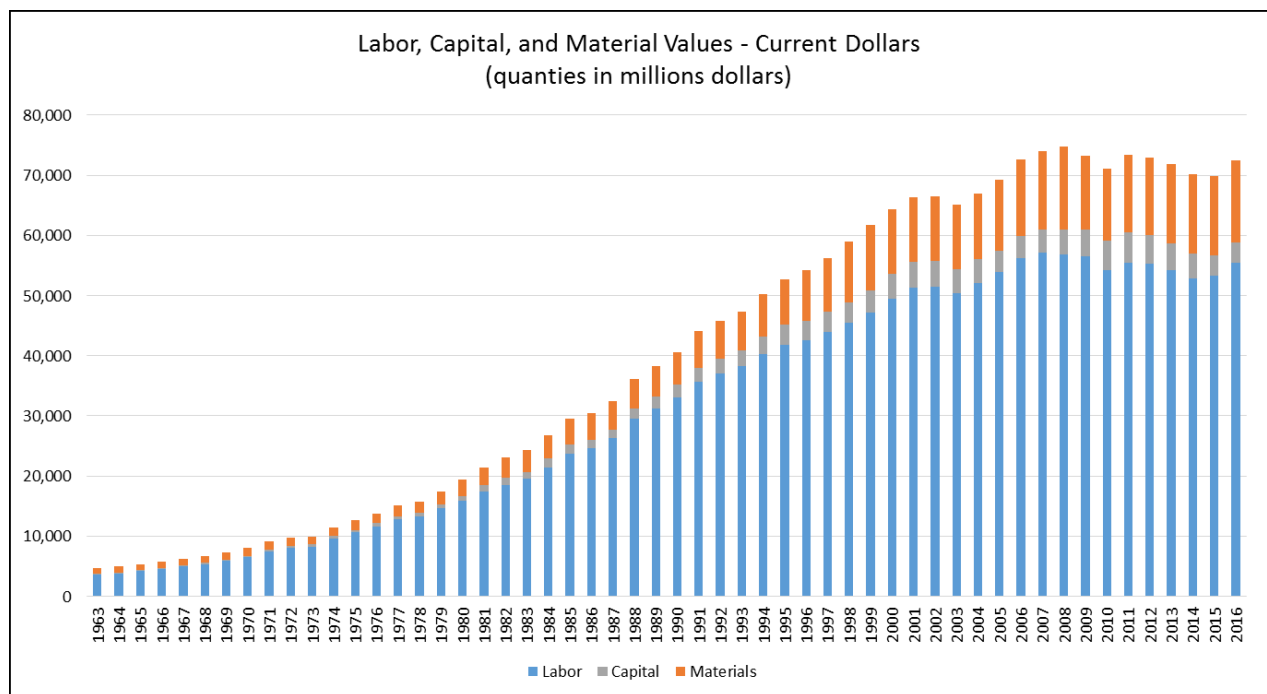
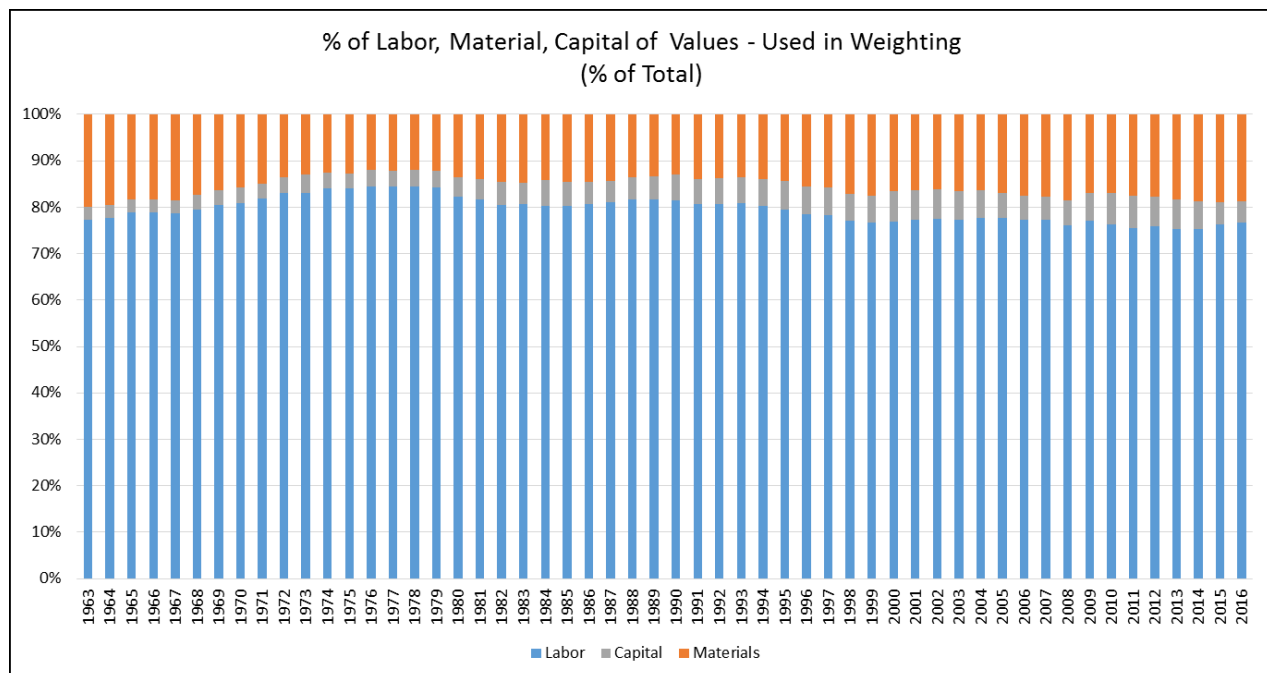


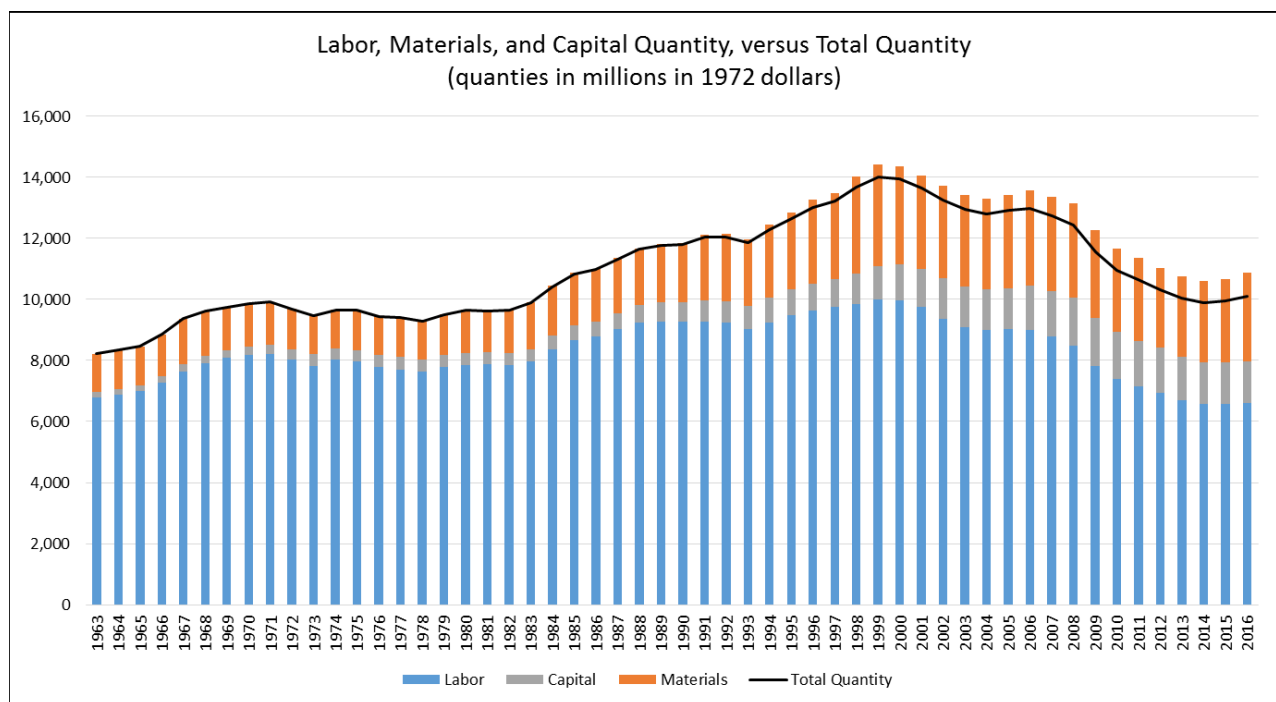
Figure 33: Percent of Value – Labor, Materials, & Capital



- The value of labor, capital, and materials increased almost steadily until the recession of 2008.

- The next several years saw very small declines in the value of the inputs.
- The Quantity change from the previous year is weighted using the percentage share of current and previous year actual dollars.
- The weightings of the input show an interesting story.
 - Since 1975, labor has very gradually declined in the weighting of total postal inputs.
 - At the same time, materials have increased in share.
 - Capital, which was always a small component, saw its weighting vary slightly. It plays a smaller role in TFP due to the relative small percentage of value compared to Labor and Materials.

Figure 34: Labor, Materials, and Capital Quantities



- The TFP model allows a comparison of relative quantities among the inputs of labor, capital, and materials.
- Labor peaked in 1999. Automation and other programs coupled with increased use of workshare by customers led to less of a demand for labor.
- Capital quantities increased for a while and materials moved slightly up and down reflecting to a certain degree changes in fuel costs affecting transportation.
- However, the decline of the largest input component, labor, caused a simultaneous decline in the quantity of all inputs.
- The TFP methodology used the ratio of change from the current year to the previous year, weighted using the average percentage of the actual dollars over the two years.

Figure 35: Current Dollar Labor Compensation by Occupation

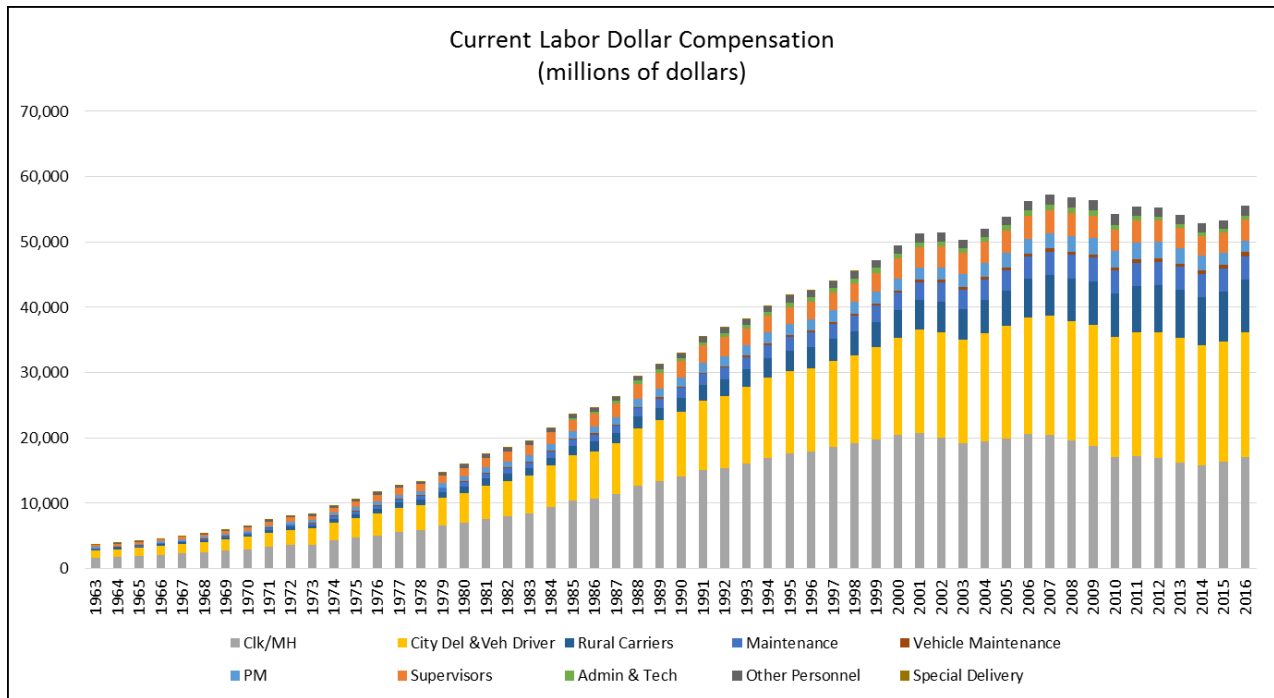
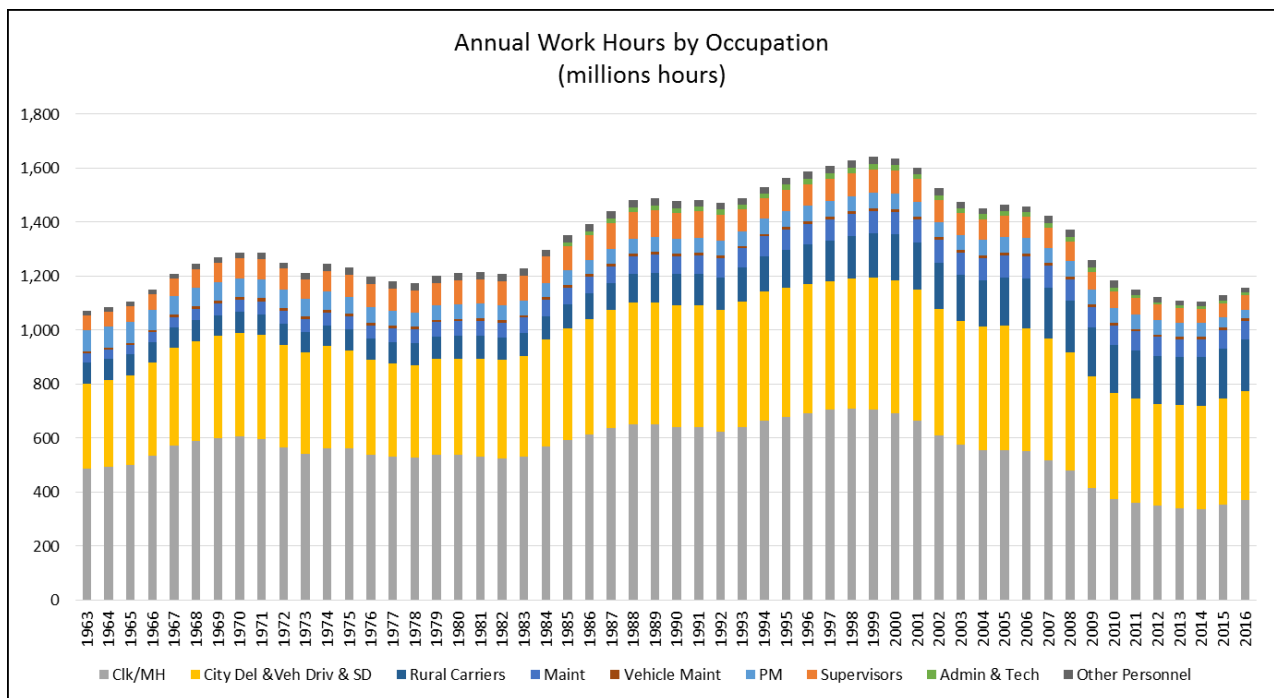
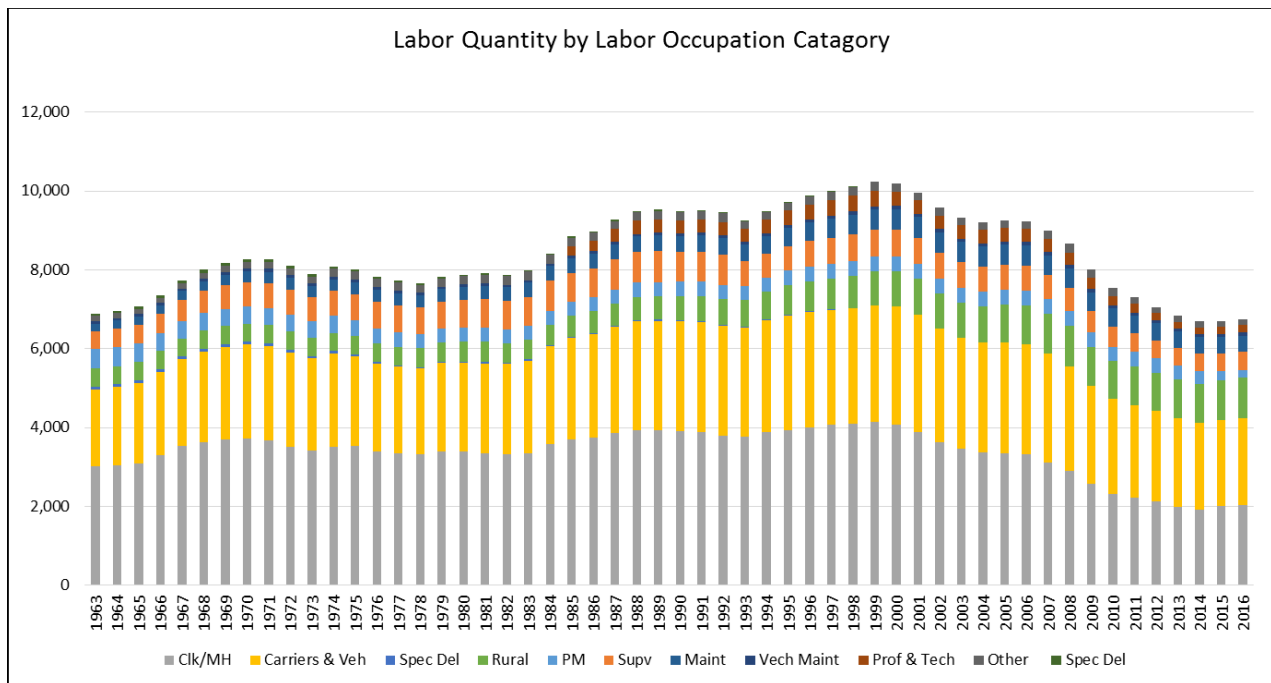


Figure 36: Annual Workhours by Occupation



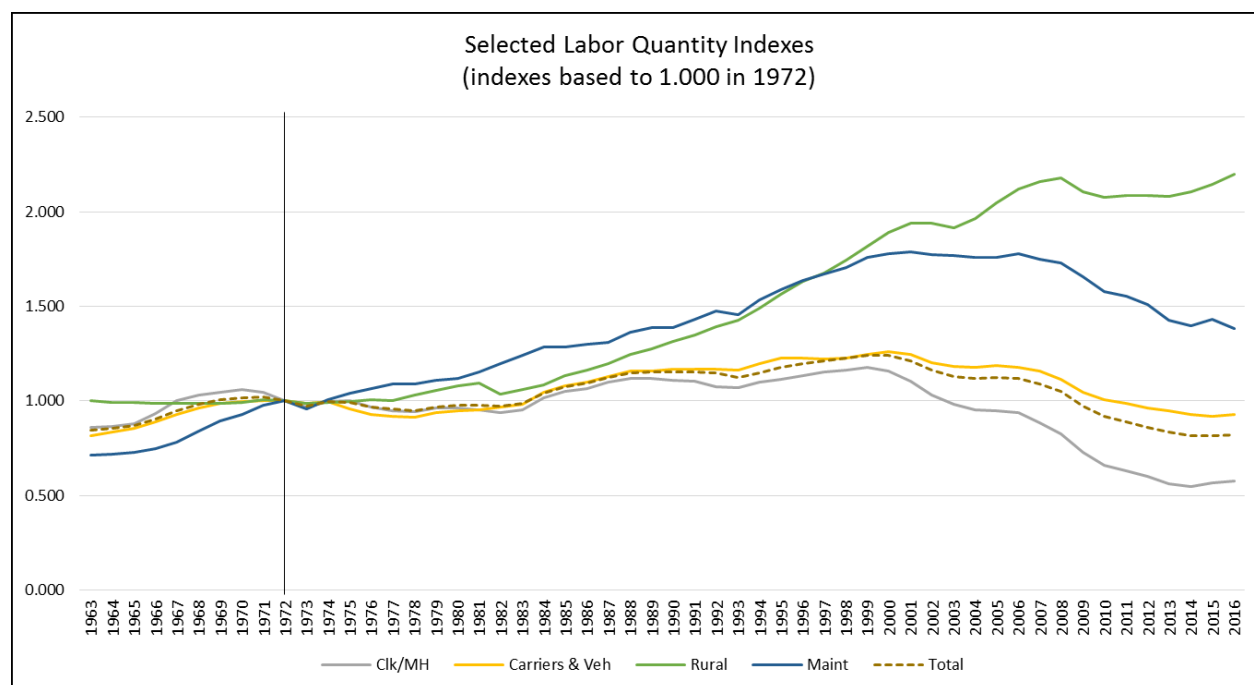
- These two charts show the compensation and work hours of major employee classification categories.
- A significant decline in the formerly largest category, clerks and mail handlers, which started in 1999, has led to overall declines in workhours.
- It is also worth noting the decline in city carrier work hours in the 2000's as efficiency programs focusing on automating the sequencing of mail for carriers was implemented.
- Figure 35 shows that pay increases reduce the impact of fewer hours worked as shown in Figure 36.

Figure 37: Labor Quantity by Occupation Category



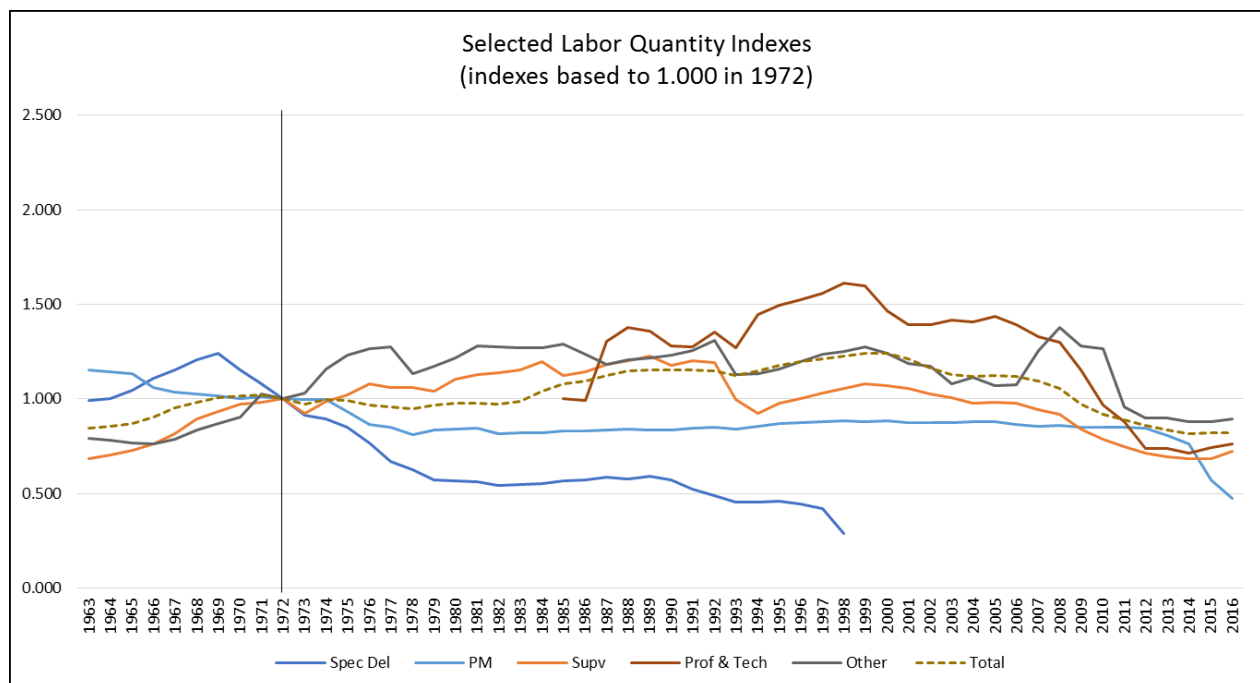
- The chart shows TFP labor quantities reflecting the trends previously discussed with regard to workhours.
- Clerks and mail handlers along with city carriers to a slightly lesser degree are declining.
- Rural carriers are increasing.

Figure 38: Labor Quantity Indices – Clerk / Mail Handler, City Carriers, Rural, & Total



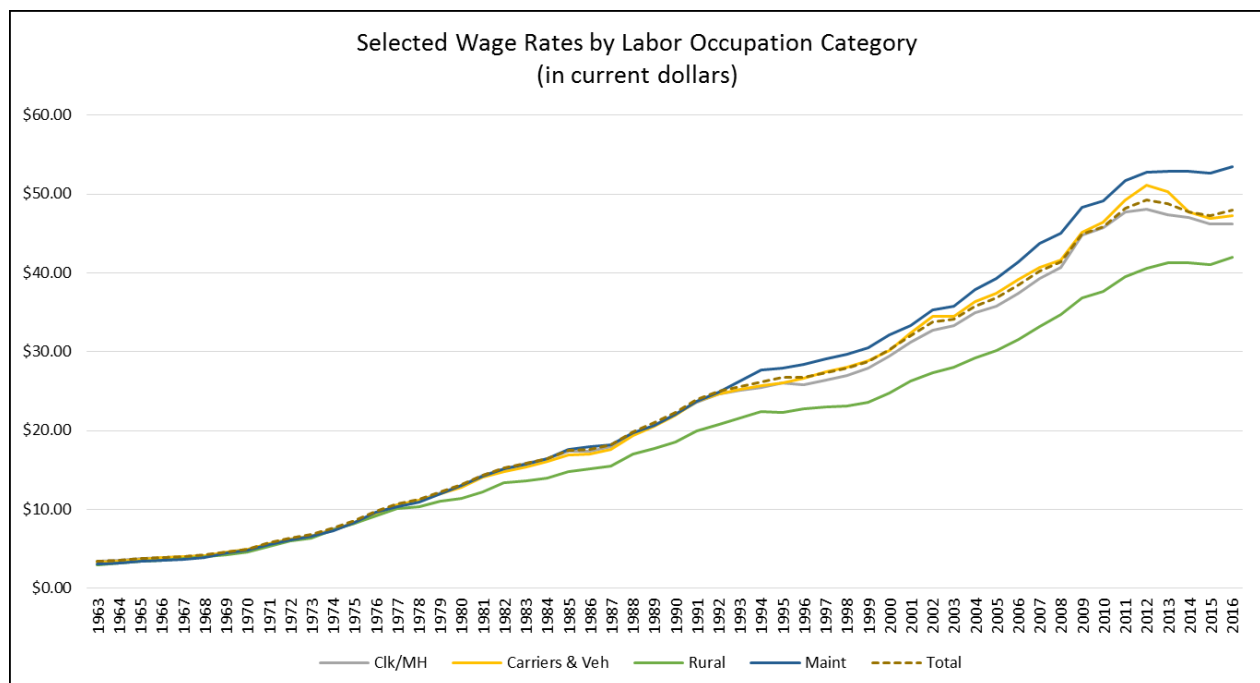
- The line graphs depict the trends in postal labor crafts clearly.
- Clerks and Mailhandlers fall the most dramatically followed by city delivery carriers
- Much of the growth in the delivery network is in exurbia or formerly rural areas which are handled by rural carriers.
- That growth has driven the increase in the number of rural carriers.
- Maintenance employees saw larger increases through 2000 as equipment and building maintenance became more demanding with the increased size and complexity of equipment.
- However, the same forces affecting Clerks and Mailhandlers have reduced maintenance employee quantities since then.

Figure 39: Labor Quantity Indexes – Selected Occupations



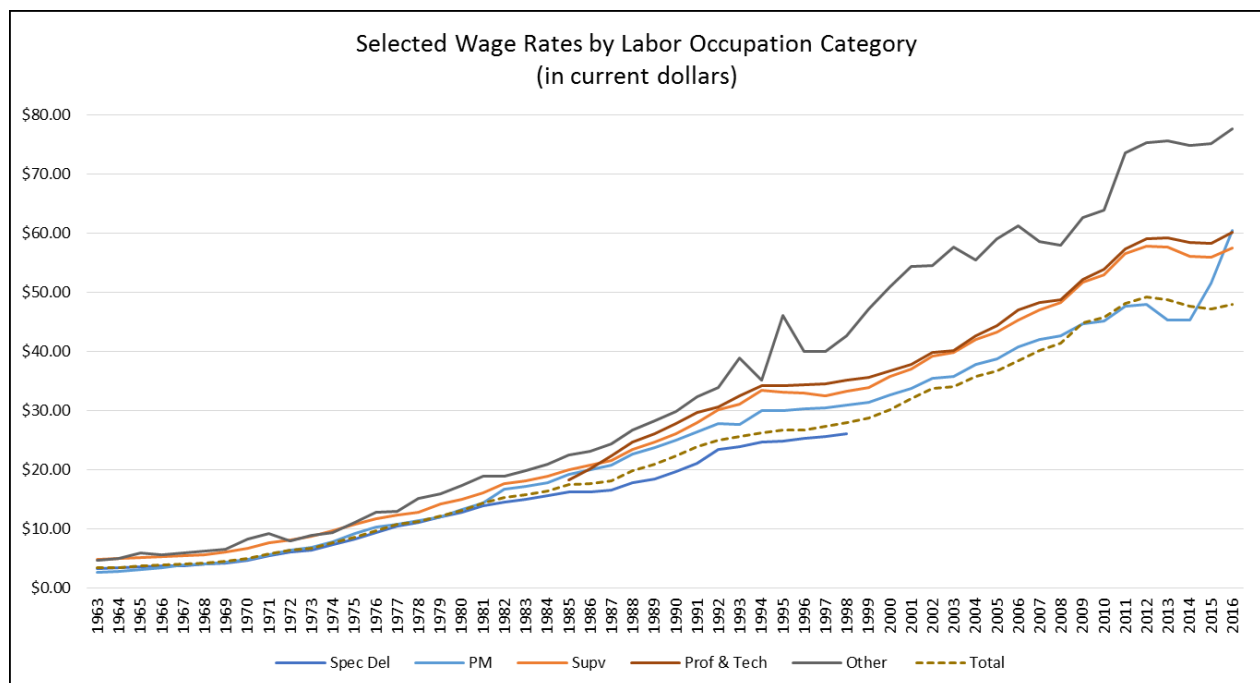
- This graph depicts other employee groups.
- Special delivery messengers saw rapid declines as overnight services and two-day services became popular in the 1970's and continued to grow.
- Postmaster quantities remained stable until an agreement was reached in 2014 which let certain postmasters cover multiple small offices.
- Otherwise, the chart shows stable then declining quantities for professional, administrative, technical, and supervisor categories.

Figure 40: Wage Rates by Labor Occupation – Clerk/MH, City Carriers, Rural, & Maintenance



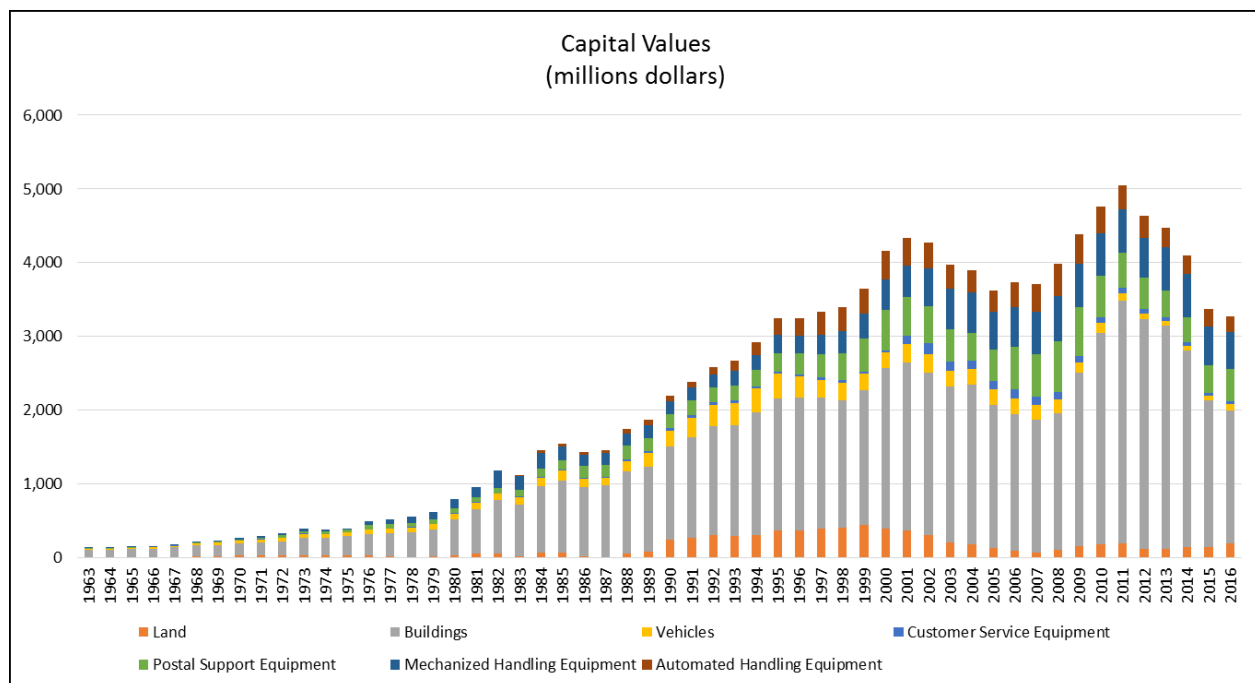
- The wage rate chart shows gradually increasing wage rates until the round of labor negotiations that occurred in the 2011-2012 time frame.
- Those negotiations slowed some increases and allowed new, lower rate employee categories for Clerks and City Carriers. This has resulted in a large shift from career to non-career employee use over the past five years. It has caused the composite wage rate to actually decrease for these occupation groups.
- Since 1980, Rural Carriers have tended to be paid less than other postal categories.

Figure 41: Wage Rates by Occupation – Selected Categories



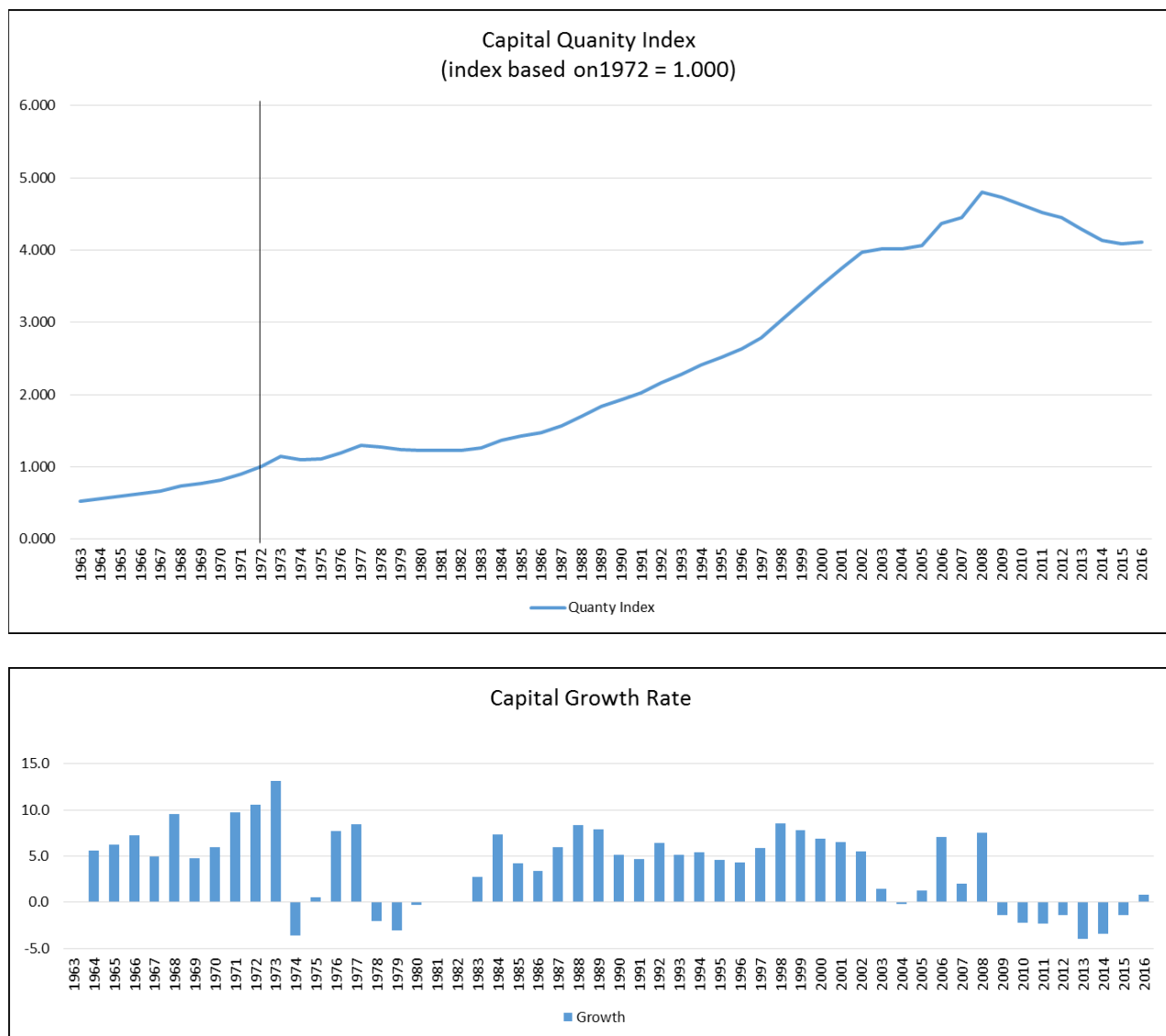
- The second chart shows gradual pay increases for most management/administrative categories.
- One exception is the bump in pay for Postmasters pay in 2014 where the group saw a simultaneous decline in quantity as explained previously.
- The other category appears to include Postal Executives and saw relatively large pay increases from 1997 to 2007 and a spike in 2011.

Figure 42: Capital Values by Category



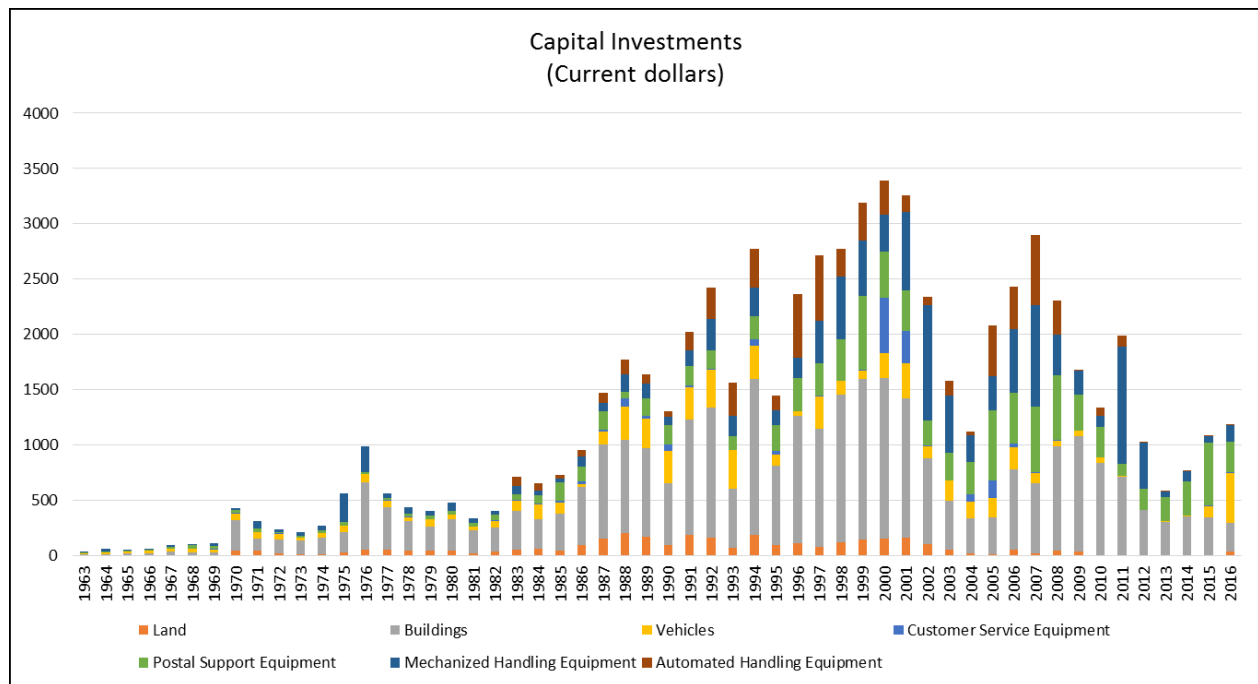
- This chart shows the value of the capital assets peaking in 2001 and again in 2011.
- Building values have begun to drop since 2011 reflecting to some extent the sale of facilities.
- The value of the vehicle category has declined since 1999 reflecting the aging of the long-life carrier vehicles.
- In 2016, the TFP data shows that \$452.9 million was invested in the Vehicle category. This large investment in Vehicles in 2016 barely made a dent in the 2016 Capital Value for the Vehicle category.
- The value of automated handling equipment is declining representing the aging of much of the equipment.

Figure 43: Capital Quantity



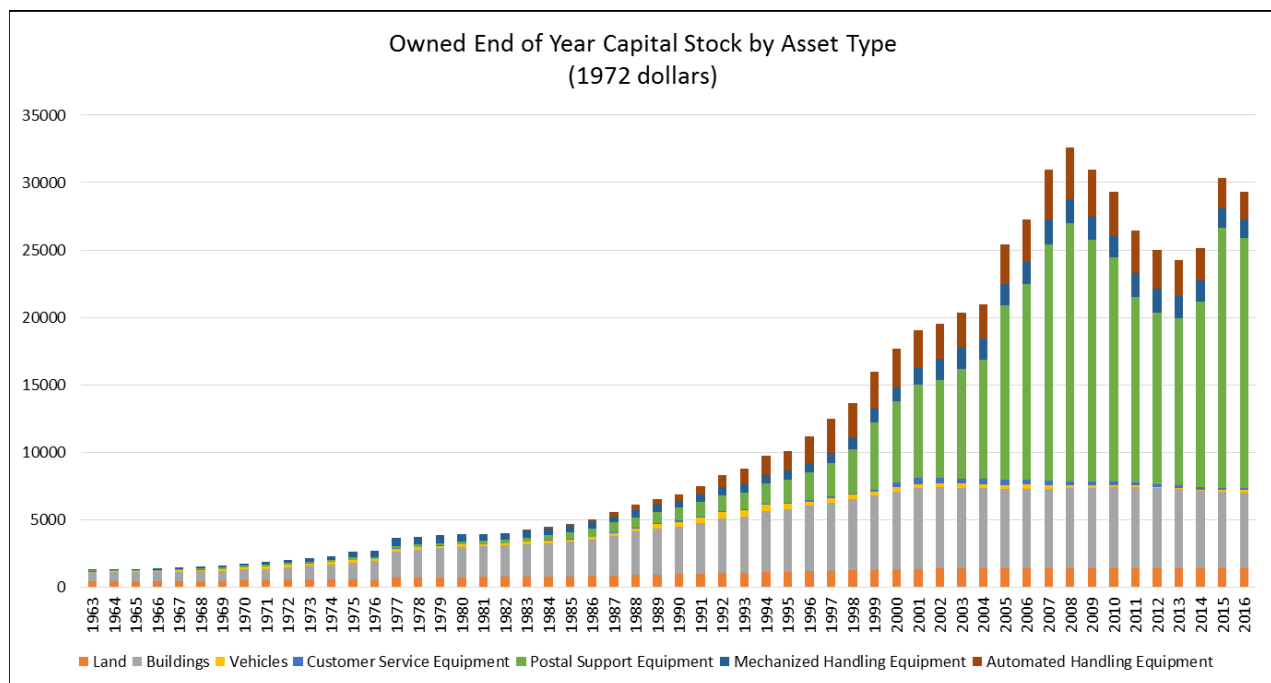
- The capital quantity index used by TFP provides a means to track and analyze the amount of capital stock the Postal Service maintains.
- The index shows a steady rise in capital from 1982 until 2009 and subsequent declines.
- That can be seen in the bar graph that shows declines in the capital growth rate from 2009 until 2016.
- Capital Quantity is calculated on a quarterly basis using a perpetual inventory type process.

Figure 44: Capital Investments in Current Dollars



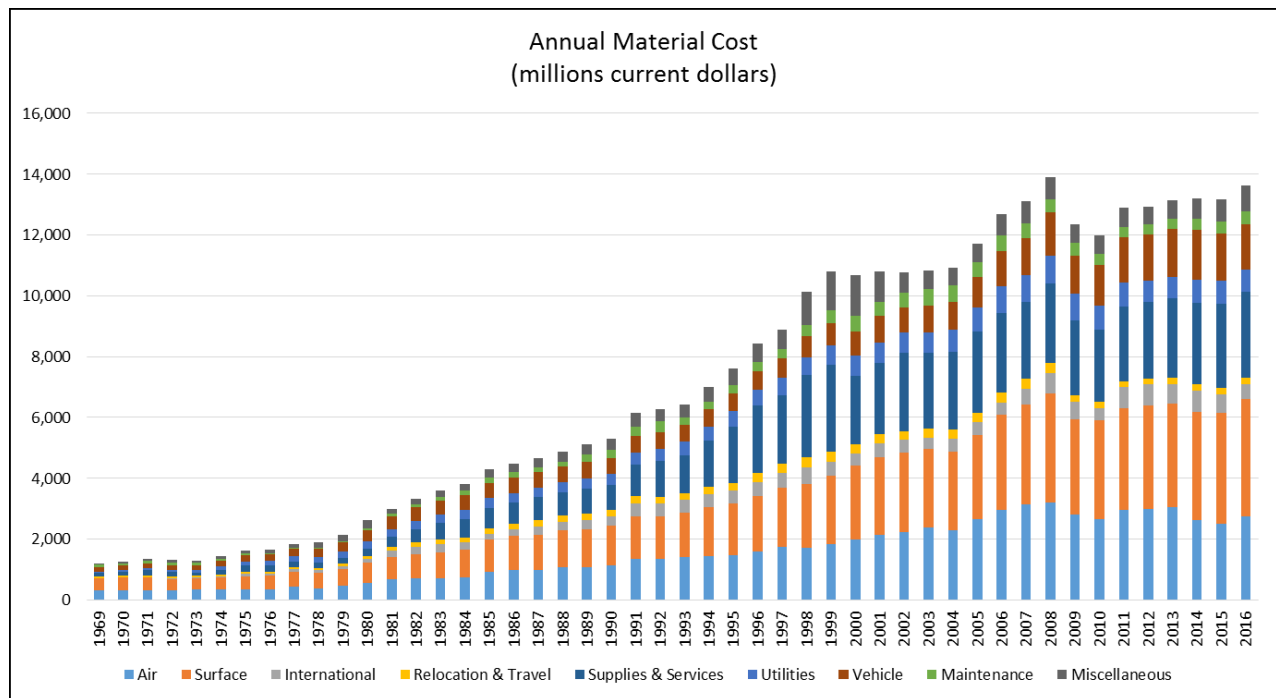
- FSS is shown as Mechanized Handling Equipment in 2010 and 2011.
- In 2016, a substantial investment was made in Vehicles. Only the current year impact of the investment gets reflected in the TFP Value and Quantity results.
- Overall, Capital has a small role in the TFP results.

Figure 45: Owned End of Year Capital Stock by Asset Type



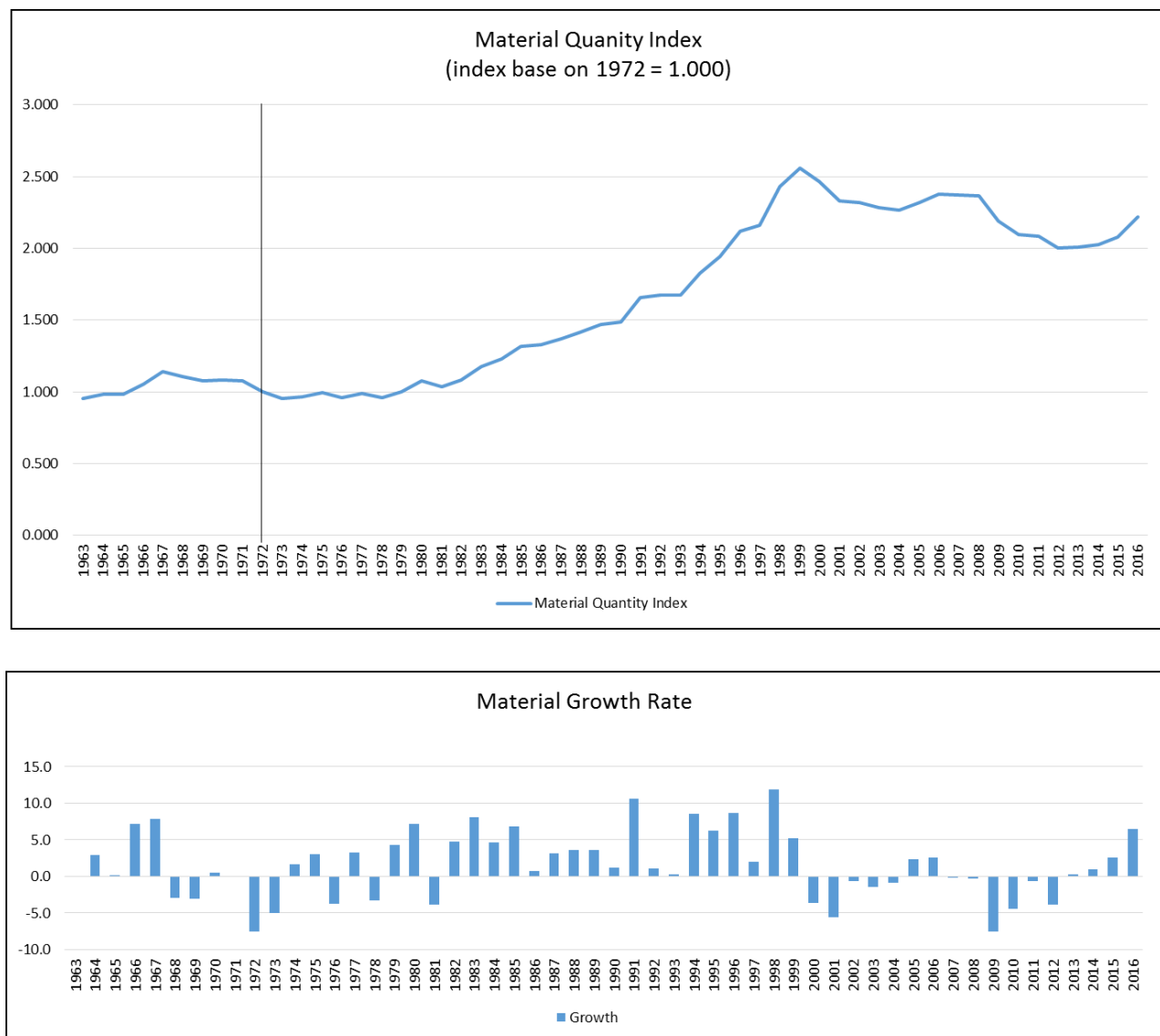
- The spikes in investment in automated handling equipment in much of the mid 90's and then again in 2004-2008 with FSS.
- The bar for 2016 also shows renewed investment in carrier vehicles.
- The second chart shows the owned capital stock assets.
- With all of the discussion of vehicles, automation and buildings, the largest owned capital stock by asset type is Postal Support Equipment.
- Postal Support Equipment is a form of the “none-of-the-above” category consisting of everything from containers to materials to office equipment.
- Postal Support Equipment includes data processing and communications equipment, both rental and owned.
- Postal Support Equipment has tended to increase over time.
- Even a substantial purchase made only a small difference to a large motor vehicle stock. This could also be related to the timing of the quarterly calculation methodology.

Figure 46: Annual Materials Cost



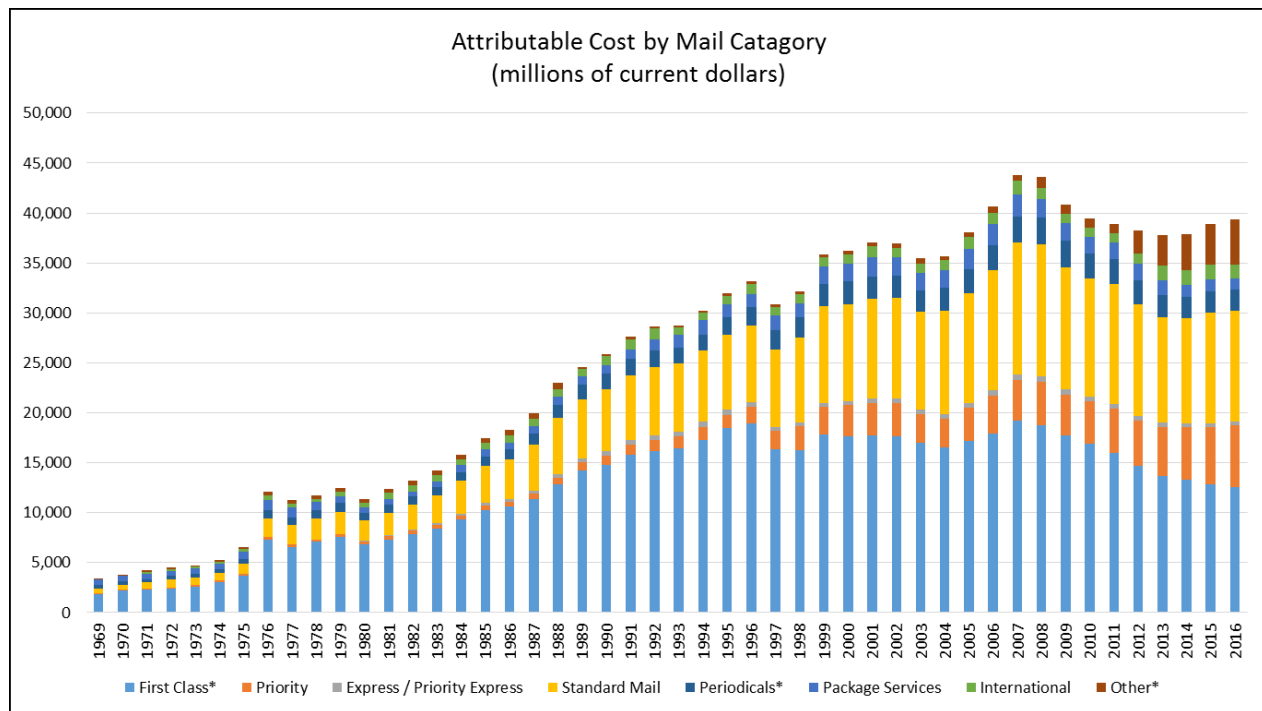
- Annual material costs have increased over time.
- Air and surface transportation drove much of the increase.
- Supplies and services tended to grow until the 2008 volume decline and have stabilized since then.
- Though a relatively small segment, Vehicle Services in Materials have grown with the aging of the vehicle fleet.

Figure 47: Material Quantity



- The material quantity index grew until 1999 and declined, for the most part, through 2012.
- The bar chart shows the uptick in the material growth rate over the past three years.
- That uptick coincides with conclusion of the rapid volume output declines that started in 2008 and began to slow down in 2012.

Figure 48: Mail Volume - Pieces



- Within First Class, Standard, Periodicals, Package Services & International, there are Mail Class Products.
- Mail Products are used to create the Weighted Mail Volume Output index.
- Attributable Cost is used to weight the mail piece volumes to create the Weighted Mail Volume result.
- The ratio of the change in piece volume from the current year to the previous year is weighted using the average of the percent of attributable cost for the two years.
- There was an extra quarter in 1976 due to the change in the start of the Fiscal Year from July to October. This was adjusted in the Workload result before calculating TFP.
- There have been changes in the definition of “Other” since 2008 in the calculation of Quantity. These changes appear to be related to reporting of results rather than the methodology for calculating Quantity at the category level.

Figure 49: Attributable Cost by Mail Product Category

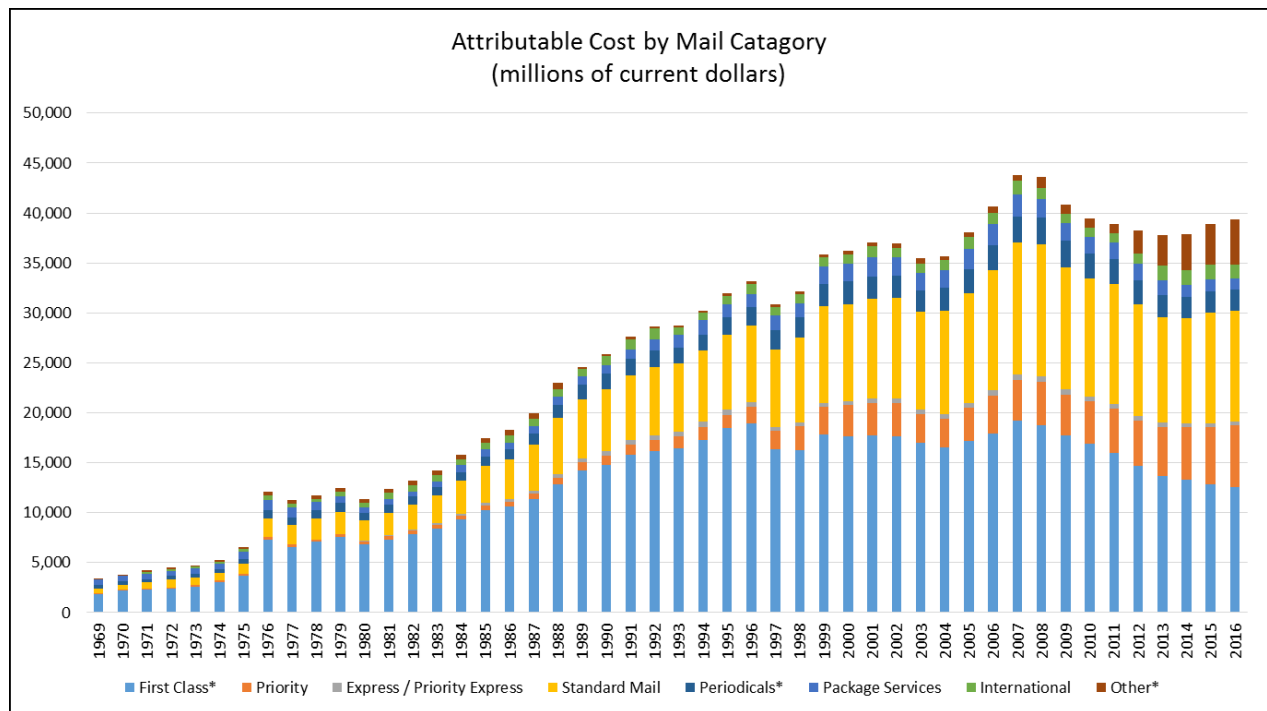
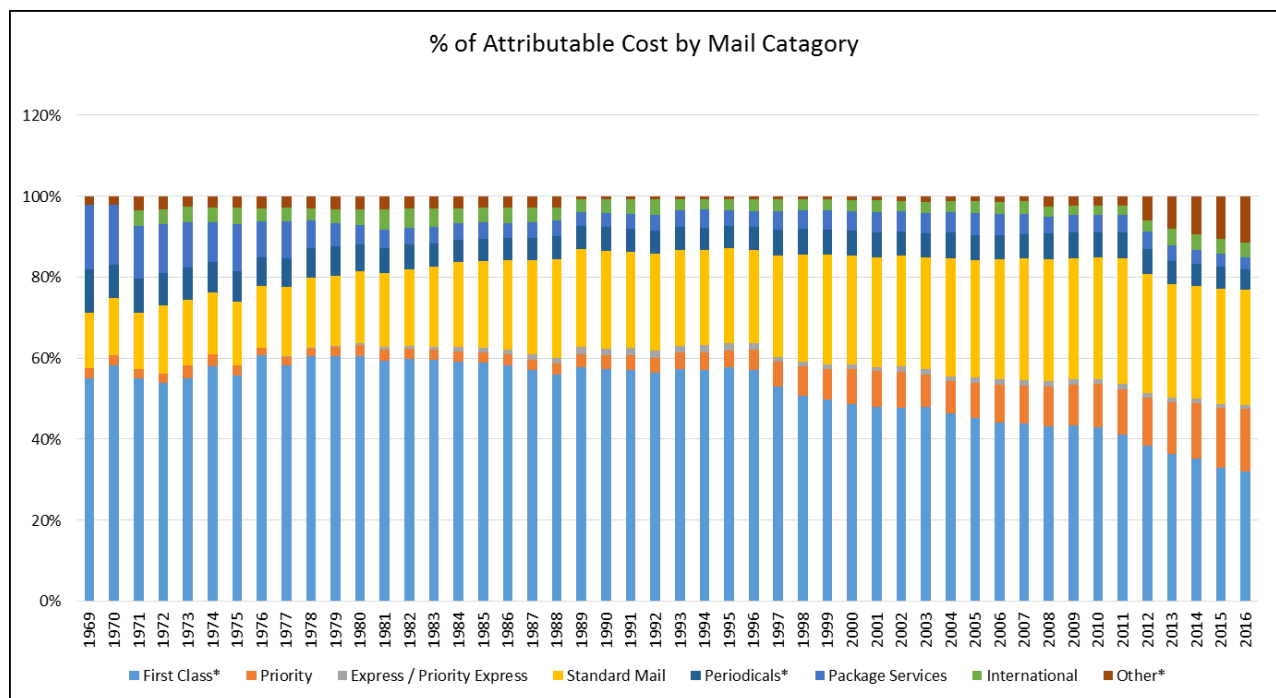


Figure 50: Percentage of Attributable Cost



- The percentage of Attributable Cost is used in the weighting of the piece volumes.

Figure 51: Weighted Mail Volume / Quantity

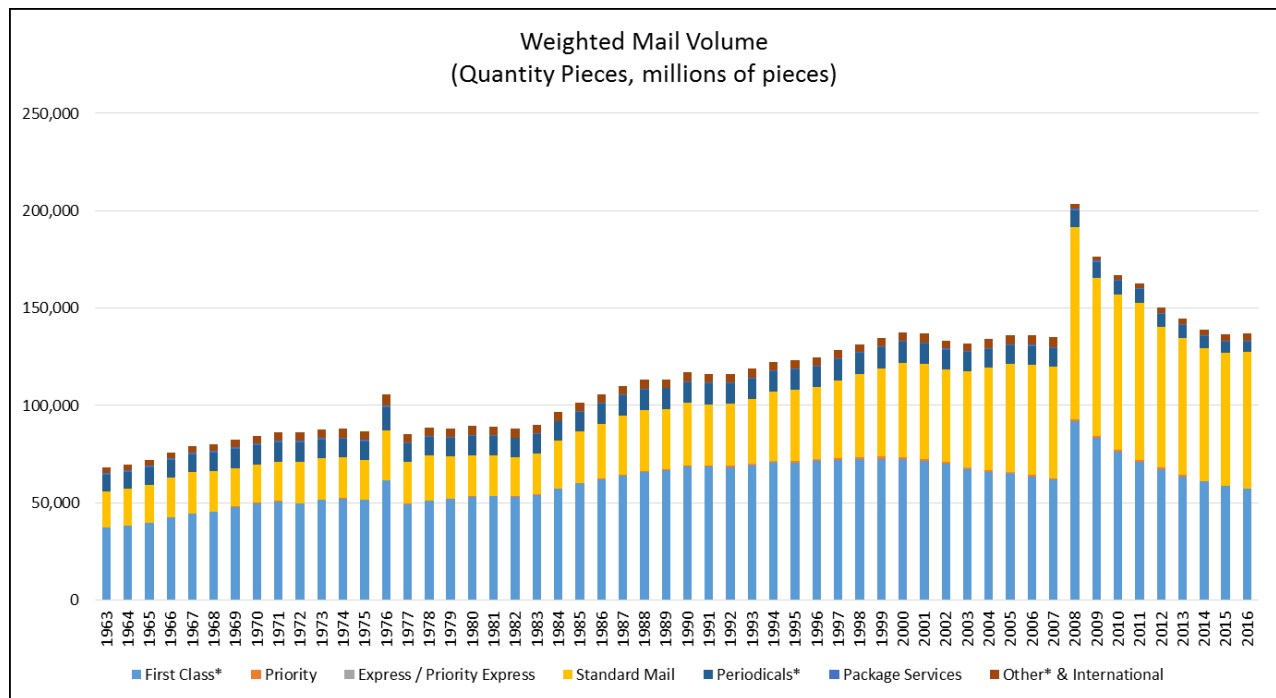
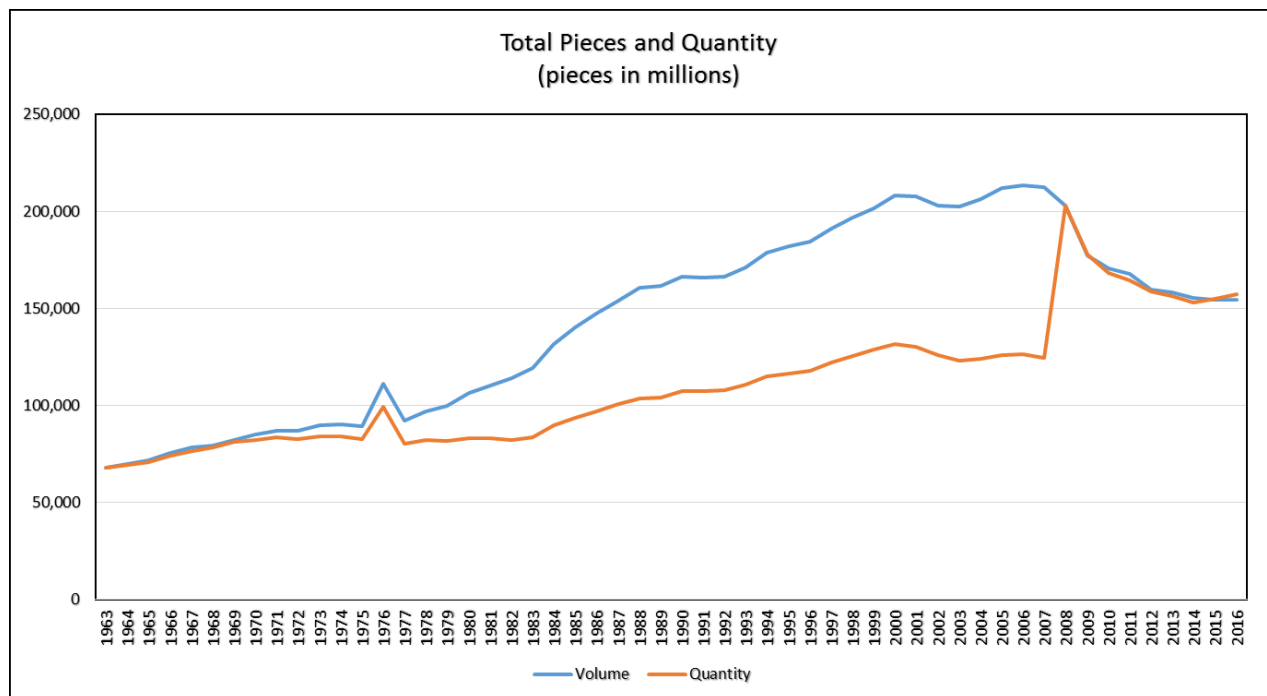


Figure 52: Actual Pieces to Weighted Mail Volume Quantity



- In Mail Volume, major changes were made in mail classifications in 2008, due to PAEA. The TFP model methodology used this change to reset the Quantity baseline to 2008 pieces.

- Over the years, the quantity result for weighted mail volume diverges from the actual number of pieces. This can introduce distortion in results. For some Mail Products, the Quantity equals the number of pieces.
- This results in a factor to make an adjustment to the final Weighted Mail Volume index. This appears to be an appropriate adjustment methodology. This is shown as the spike in Quantity in 2008.
- The relationship between the Quantity and Pieces is shown to be closer after this adjustment.
- Moving forward in 2009, Quantity is calculated without an adjustment factor, as it used the current year and previous year volumes in the calculation.
- It will be further evaluated in Report 2 as part of the Before / After PAEA analysis.
- Attributable Cost per Piece trend lines is shown in the following page as Figure 53 and Figure 54.

Figure 53: Cost per Piece

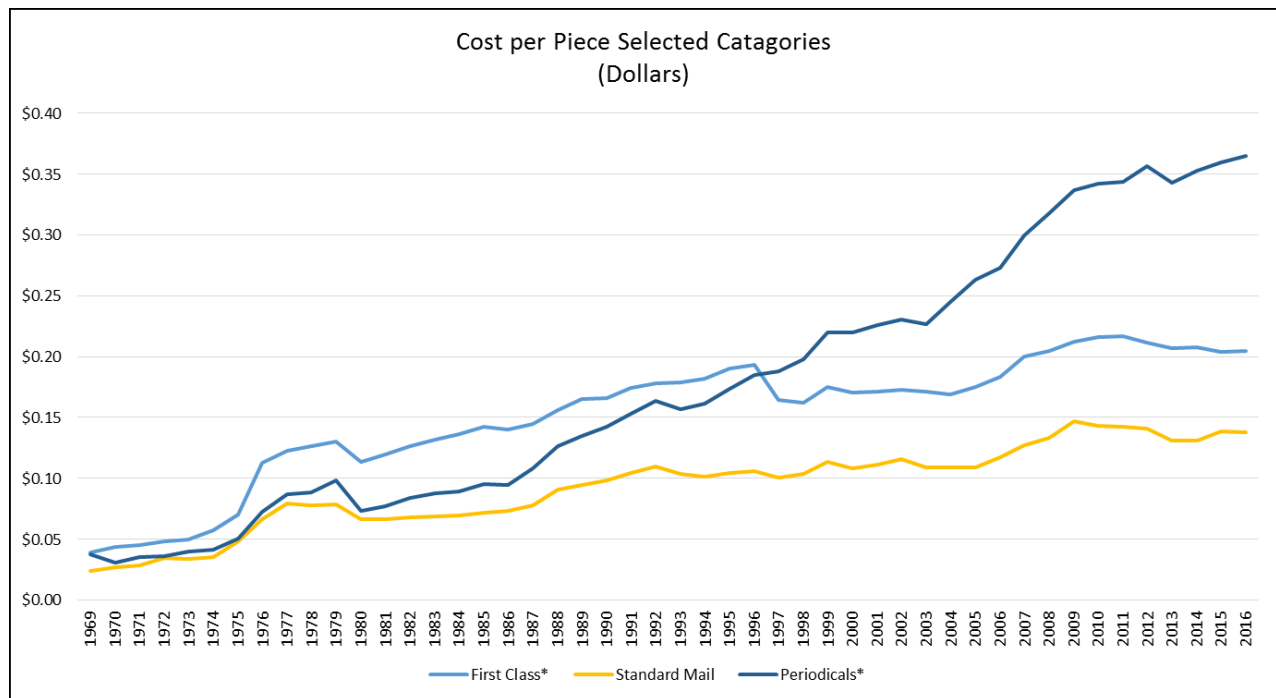
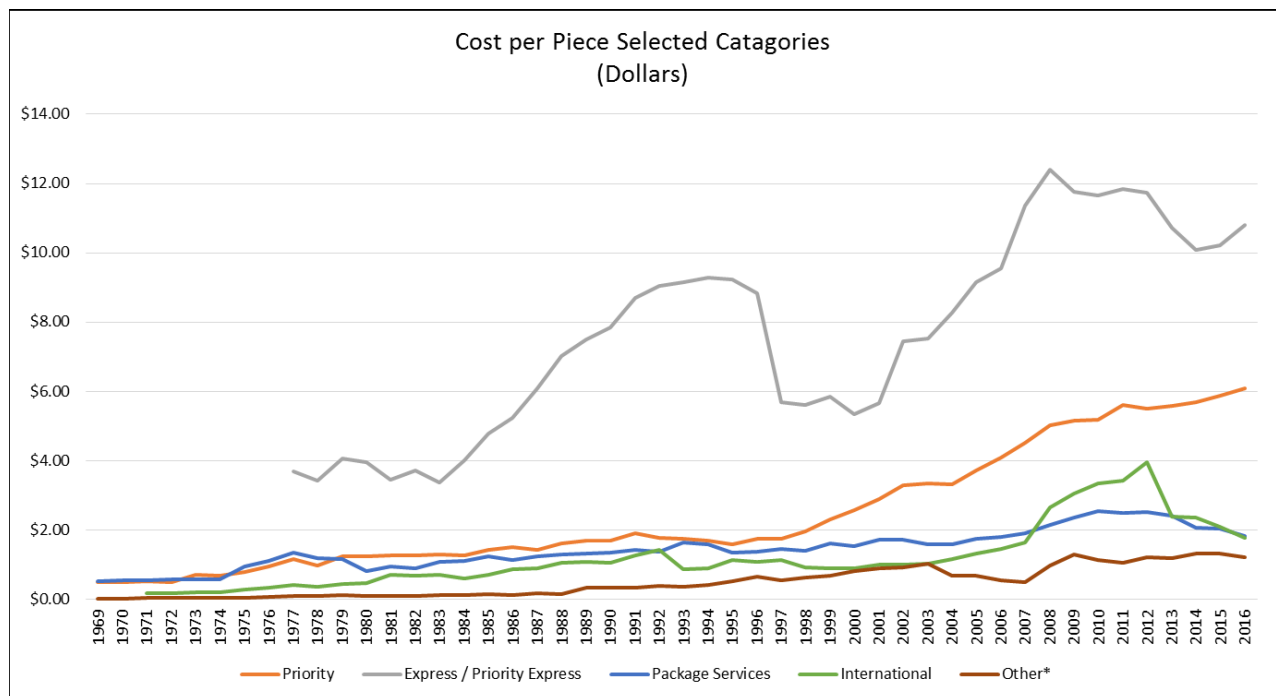


Figure 54: Cost per Piece



2. Analysis of TFP Results

A. Key Components in TFP

The following are the key components in TFP. These are the components that most influence the TFP results.

1. TFP is weighted based on Value, with Labor accounting for approximately 76 percent of the cost in recent years. Materials, primarily driven by Transportation, accounts for approximately 18 percent in recent years. The remaining weight is Capital, at approximately 6 percent. The shifts over the historical period have not been significant.
2. Within Labor, the changes in operations categories have the most impact. The reduction in the number of hours is the primary cause of the reduction in Labor.
3. The recent shifts from career to non-career hours have had a large role in the reduction of Labor Input in recent years.
4. Mail Volume reduction has had the largest impact on Workload. The reduction in First Class Mail, along with corresponding change in Attributable Cost share, has been the primary cause of the Output reduction.
5. Network (Possible Deliveries) has had a linear growth impact on Workload.
6. The weighting factor used to combine Total Output and Network to create Workload is a key input in the final TFP value. This will be reviewed in detail in Report 2.

The following items summarize the key observations of the TFP methodology.

1. The Postal Service, overall, did a good job of matching inputs, particularly labor and materials with changes in output or weighted mail volume and miscellaneous services.
2. Subtle, positive differences in labor and materials usage compared to workload growth or decline led to productivity increases.
3. No productivity increases were due to dramatic changes in an input or workload component.
4. Even though labor has a slightly smaller weighting now than 50 years ago, it still is the driving input to TFP changes.
5. Until relatively recently, output (weighted mail volume and miscellaneous output) drove the workload measure because mail volume was growing.
6. Since 2008, the sharp declines in output resulted in mostly negative output productivity.
7. The growth in the delivery network push up workload slightly.
8. That positive delivery network effect has turned negative output productivities in some recent years to positive TFP that includes the delivery network.

B. Factors that Affect TFP Results

In summary, TFP does contain a complete set of data factors and applies them through an effective methodology to reach an accurate result. This section looks at the factors that affect TFP results. These factors are split into two groups for this purpose: underlying factors and exogenous factors.

Underlying Factors

The Underlying Factors would be those that are considered as within the Postal Service's control or influence. These are essentially programs and policies created by the Postal Service, aspects of operations, strategies to meet performance requirements or pricing discounts designed to reduce costs and incent new volumes. Examples include the following:

- The operational changes that transformed mail processing operations from manual and mechanized sorting to completely automated letter and flat sorting.
- The impact to delivery operations of Delivery Point Sorting (DPS) for letters and the Flat Sequence Sorting (FSS).
- The advent of presort discounts in 1976 where customers began taking over some of the mail sorting activities formerly done by the Postal Service.
- The Standard Mail carrier route presort discount implemented in 1978 that proved fortuitous in allowing the Postal Service to realize its share of the growth in the advertising market in the early 1980's.
- A number of discounts were implemented in 1991. Some of these encouraged customers to barcode their mail thereby enhancing the automation program. Others encouraged customers to deposit Standard Mail, Periodicals along with Parcel Post closer to the delivery destination. These discounts reduced costs and improved customer incentives to use the mail.
- Capital programs that replace labor with automation or mechanization in operations, or that add value to the product offering.
- The management of the growth of package volumes due to ecommerce, including the role of work sharing product categories (e.g., DDU Parcel Select in 1998).
- The advent of Delivery Confirmation allowed parcel shippers to gain more visibility into the delivery of their product.
- The impact of network optimization and mail processing plant consolidation.
- Capital expenditure process impacts, including periods of freezes or limited availability.
- The type of impact a major infusion of capital has on TFP.
- How periods of substantial volume change (growth in the early 80s' or declines in the late 00's) impact productivity.
- Changes in labor agreements that affect employee categories, status, and allocations.
- Changes in labor agreements that affect workload, work assignments or other productivity related factors.

Exogenous Factors

Exogenous Factors are those that come from outside the Postal Service, over which the Postal Service has little or no ability to directly control. The isolation of the impact of exogenous factors on productivity measurement through quantitative and qualitative methods is a key objective in Report 2. Part of that objective is to ensure these factors are clearly defined as part of our results. The following exogenous factors would form the initial starting point for this analysis:

- The impact of increased electronic communication and payments on mail volumes including the reduction of “clean” easy-to-process mail.
- The growth of package volumes due to ecommerce, including the role of worksharing product categories (e.g., DDU Parcel Select). The impact of adding more volume that involves a greater workload (i.e., compared to letters) should be evaluated. It is possible that the major shift in parcels with a higher operational cost may lead to a lower overall productivity measurement result.
- The large growth of advertising in the early 1980’s led to substantially more Standard Mail volume.
- The large economic recession starting in 2008 coupled with electronic diversion mentioned above led to dramatic volume declines.
- The impact of the economy on mail volume, revenues, and resource usage.

Analysis of Factor Impact

The underlying and exogenous factors will be developed further in the Report 2 process. The NWPC TFP model will be modified to support a Before and After analysis of PAEA. These factors will be used as part of this analysis. In addition, pricing factors will be added in the Report 2 process. The factors will be structured into a timeline format for inclusion into Report 2.

Another issue is whether service changes, specifically the recent declines, should be factored into the analysis of TFP results or directly into the calculation methodology. While the PRC’s concern about cost reductions that result in service declines is appreciated, that issue may be better addressed directly through various service measures. In addition, it is difficult to create a measure to account for service results in productivity based methodology. Offhand, it appears that the issue would have to be addressed either by arbitrary deductions in productivity or estimating the cost savings due to service changes and somehow putting them back into the input base.

The Bureau of Labor Statistics (BLS) provides a number of national, industry and postal productivity measures that may be relevant for comparison with TFP. An analysis of measures available through the BLS and their relevance to TFP measurement are included in Report 2.

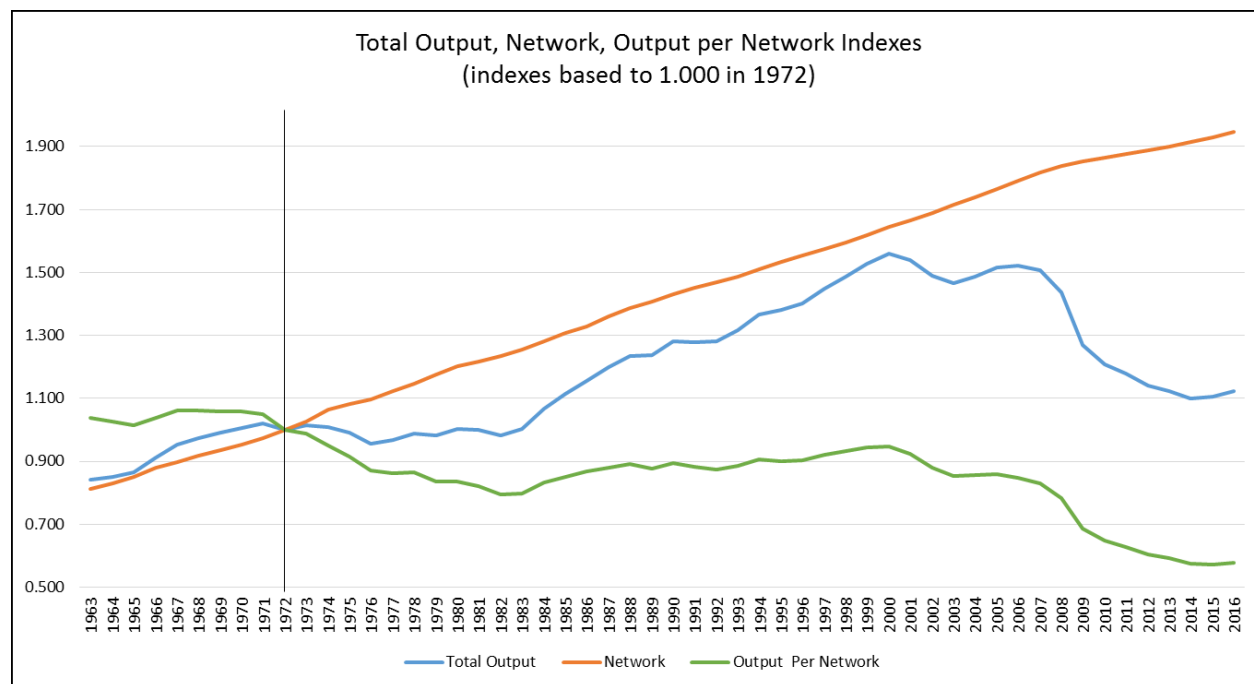
C. Comparison to Deliveries per Hour

The determination of the effectiveness of the TFP results would benefit from having alternative productivity measures for comparison. The Postal Service has used Deliveries per Total Workhour (DPTWH) for its national productivity measurement. In fact, the Postal Service has replaced TFP with DPTWH as their primary national productivity indicator for planning purposes.

While DPTWH does have some merits, it does not include several of the key features of a TFP based measurement. DPTWH does not include Materials or Capital impact on inputs. It does not directly factor in the influence of changes in Weighted Mail Volume or Miscellaneous Output. It also does not reflect the recent significant substitution of non-career employee use (at a lower wage rate) for career employees in Clerk / Mail Handler and City Carrier operations.

The TFP data set contains the elements to calculate the deliveries per hour using several different methodologies. The graph below shows the Total Output per Network as a results indicator. In simple terms, the graph shows the relationship of Weighted Mail Volume and Miscellaneous Output relative to the Possible Deliveries. This relationship could be used as a new definition of Workload to as an alternative basis for a TFP calculation. This methodology will be evaluated in the Report 2.

Figure 55: Total Output per Delivery



The following two graphs use the TFP database to calculate the Total Pieces per Delivery Point and the Deliveries per Total Work Hours. These align with the methodology currently reported by the Postal Service.

Figure 56: Pieces per Delivery Point per Day

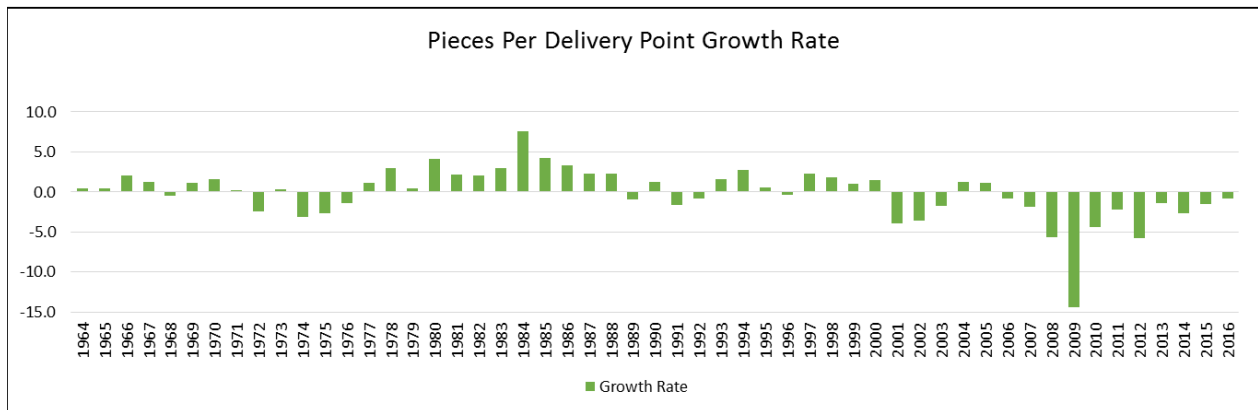
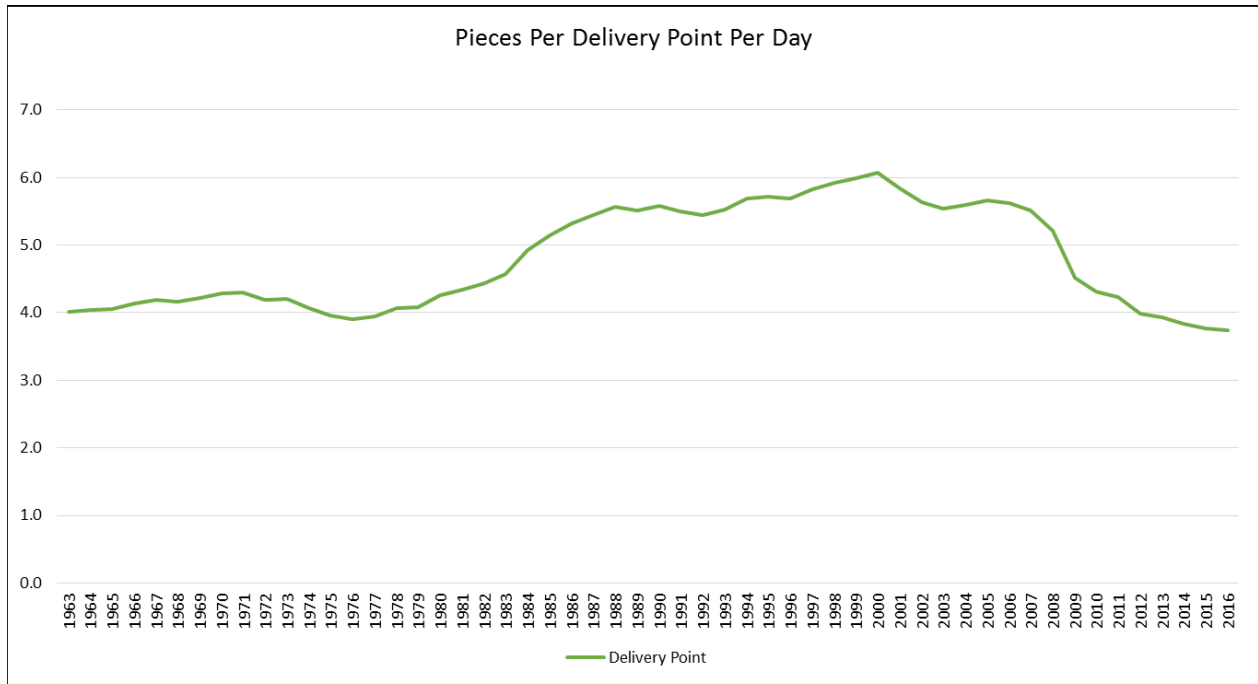
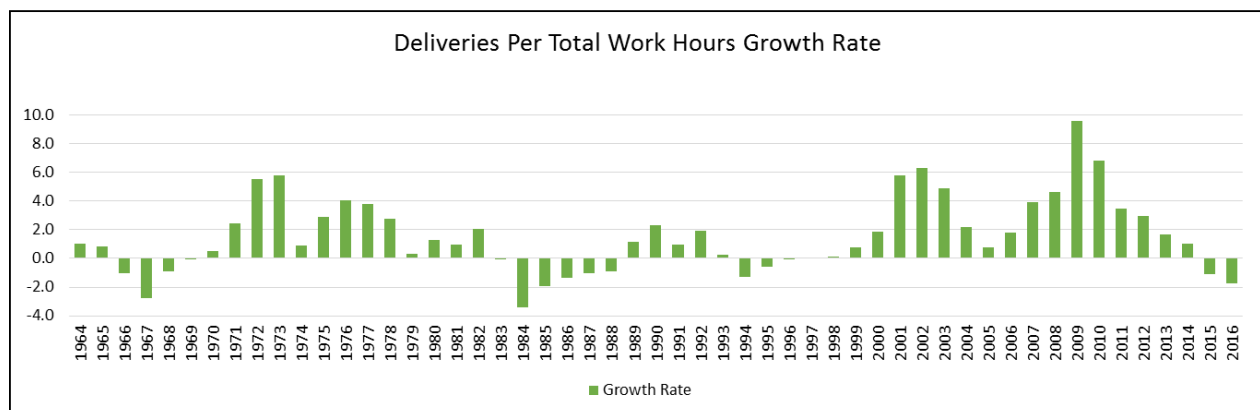
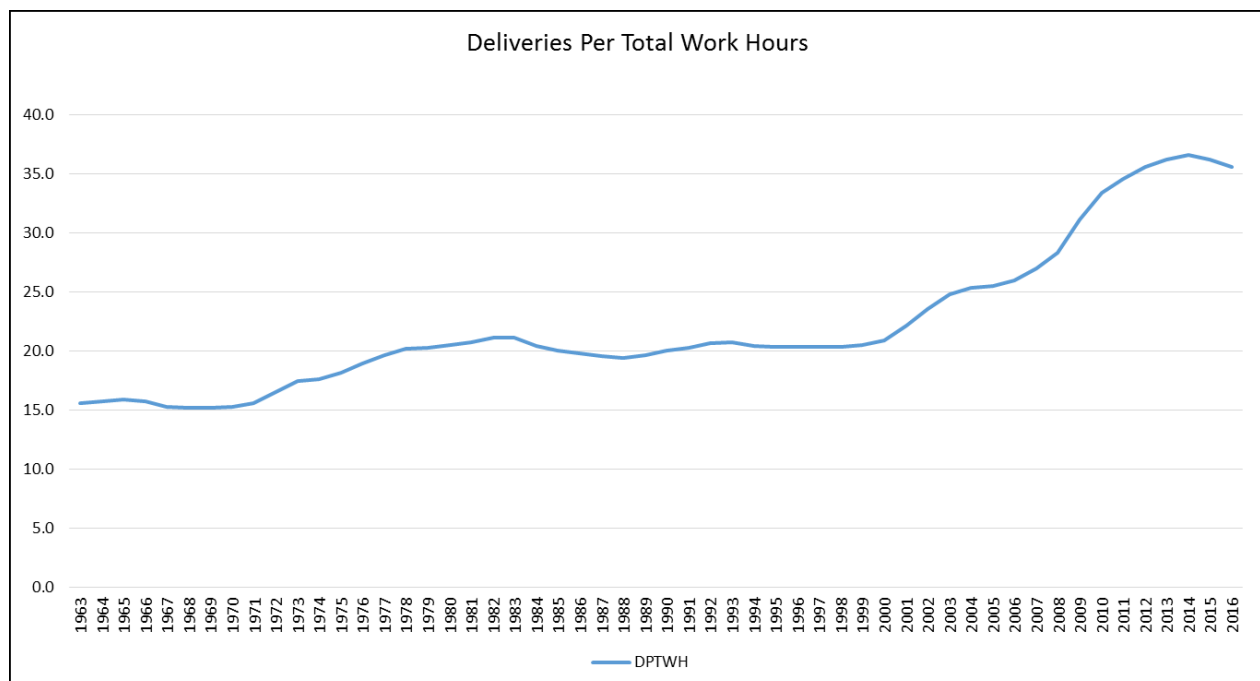


Figure 57: Deliveries per Total Workhour



There are additional metrics that could be developed based on the Mail Product data available in the TFP database. Of specific interest is the relationship of packages on productivity. Report 2 will investigate the impact of specific Mail Product trends on both TFP and with a Delivery per Hour approach.

IV. Relevance of TFP Model Results

Coming into this analysis, there were several questions about TFP in terms of its relevance as a productivity measure. The following questions are used to evaluate the relevance of TFP. This evaluation is supported by the analysis and results provided in the previous sections. The responses to these questions are further detailed in the analysis of Report 2.

1. Is the model complete and accurate?

At this point, the answer is yes.

- The model is comprehensive in that it accounts for all of the inputs in the form of the audited accounting costs of the Postal Service. These are placed into the “buckets” of Labor, Capital and Materials.
- All of the meaningful outputs in the form of mail volume and miscellaneous services weighted by CRA costs along with a factor for delivery are included.
- The impact of Possible Deliveries is weighed against the output of mail volume and miscellaneous products and services.
- The methodology follows economic standards and processes.
- The validation process did not identify any process or calculation issues that impact the accuracy or completeness of the results.
- There are no factors or inputs that are missing from the methodology.

In short, the model appears to do what it was designed to do. It takes all of the inputs and outputs and develops a measure of total productivity. That said, there appears to be ways in which the model could be incrementally improved. These are presented in the follow section of Potential Changes to TFP Methodology.

2. Is the model relevant?

Relevance refers to how well the model measures Postal Service productivity. In short, the answer is “yes”.

- It provides a complete picture of postal productivity in that it comprehensively accounts for all of the inputs and outputs of the Postal Service.
- The model is more relevant than just the source of a single productivity measure. As illustrated throughout this report and the analytical results that can be generated from the data, the TFP process can provide useful insights on what is underlying the productivity performance and postal finances as a whole.
- For instance, data depicting employee mix illustrate important changes in labor usage and costs as less expensive non-career employees are substituted for more expensive career employees. TFP results reflect this shift in labor resource utilization.

- The graphs describing capital illustrate the impact of various programs such as BCS and FCS implementation. It also shows the recent efforts to begin replacing the carrier vehicle fleet. However, as the capital process, in simple terms, reflects the current value that the capital inventory brings to operations, it does not have a significant impact on the TPH result. Instead, the saving generated from capital, such as automation, are reflected in the Labor input results.
- In terms of output, the gradual growth of the of the delivery network are highlighted against the declines of weighted mail volume due to the recent recession, electronic diversion and the continued growth of workshare. The relationship between mail volume and possible deliveries is examined in detail in Report 2.

3. Is the model transparent?

One of the main goals of the PRC is transparency in the reporting of Postal Service information. With that in mind, the answer is “no” as to whether the model is transparent.

- First, the complexity and sophistication of the modeling tools obscure most forms of a straightforward analysis. For instance, the TFP results are reported as growth rates from one year to the next using logarithms.
- There is no documentation that clearly explains how TFP is calculated or how it works.
- There is no documentation that explains when and how calculation methodologies change as new labor categories are implemented or, on the output side, as products change.
- The results are not prepared in a manner that makes them readily useful or meaningful. Instead, the focus is on a single number while the underlying details can tell the productivity story as the tables show in the Appendix 1. The published report is close to 100 Excel worksheets covering disjointed periods of years. There are no formulas to allow an analyst to follow the calculation process. Terms such as Quantity, Value, and Price are not documented.
- There are very useful data sets and results buried in the TFP methodology. The majority of the effort on creating Report 1 has been having to turn a set of disjointed, inconsistent excel reports of numbers into the results presented here.
- Finally, TFP is widely accepted and referenced each year in the Annual Report. Yet how it is calculated beyond a general conceptual level is not widely understood.

V. Potential Changes to TFP Methodology

While our conclusion is favorable regarding the completeness and accuracy of the TFP, there are potential changes that could make the model more useful as a reporting tool. These potential changes relate to how TFP is calculated, how the results are used in management and oversight processes, and how some of the calculations might be simplified. These potential changes in the model are described in this section.

Northwest Postal Consulting has developed a model that calculates TFP. It follows the principles and methodology of Christensen's TFP model to the extent possible. In order to distinguish the two models, this paper will use the term "NWPC TFP Model" to specifically identify the model developed for scenario analysis. A baseline result from the NWPC TFP Model will be used for comparison to scenarios where appropriate. This baseline will identify any differences between the published results and the NWPC TFP Model results.

1. Improve the Reporting & Use of Results

The TFP results are only used to provide a couple of paragraphs in Annual Reports or special studies. It should be clear from this report that TFP could provide the basis for a much broader understanding of Postal Service productivity performance. The results could lead to better insight into other process. However, this would require the following actions:

1. Improve the reports showing information on inputs, outputs, and results. The results in this report provide a good starting point to demonstrate the value of the TFP process.
2. Examine measuring year-to-year productivity improvements by the traditional percentage comparison as compared to a logarithmic approach. This would make it consistent with other management reporting processes.
3. One of the goals in the development of the model would be to determine if a simplified approach is appropriate. Generally speaking, there is no way to substantially simplify the TFP methodology. Instead, there should be better documentation and a process to educate interested parties on TFP. This is essentially the transparency issue discussed in the previous section. However, there are some methodology adjustments that could take out minor factors.
4. This understanding and presentation of TFP could use the same types of data, but aim to consolidate, simplify, and publish the results in an effective manner. The objective would be to make the productivity measurement more effective through this simplification. This new model would have the following objectives:
 - a. Highlight responsiveness to recent changes in underlying or exogenous factors.
 - b. Segregate those factors that are more directly controllable by the Postal Service versus non-controllable factors for further analysis.
 - c. Relate more directly to the annual plan and compliance review processes.
 - d. Insure the model is immune from manipulation such as intentionally realigning assignment of inputs to affect the results

In summary, the TFP methodology is relevant and valid. The presentation of results is not relevant or transparent. The results are not used. With changes and education, the methodology could be easily understood. This would cause results to be used, leading to better understanding of the impact of strategic programs, management initiatives, and operational processes on productivity performance.

2. Workload Weighting Factors

As previously indicated, on the output side, the model reflects all of the outputs using the buckets of cost weighted mail volume, cost weighted miscellaneous services (primarily special services) and Possible Deliveries. As such, the model appears to have a place for all outputs.

The Weighted Mail Volume and the Miscellaneous Output are combined using the weighed Attributable Cost of each, resulting in Total Output. Total Output is combined with Network Output, i.e., Possible Deliveries, using a weighting factor, to create the final Workload Index. Christensen based the original weighting factor on econometric analysis during the development of TFP. It was set at 78.8% Volume, 28.2% Deliveries. In 1999, it appears to have been arbitrarily reset to 70% / 30%. In 2016, it was again reset, this time to 63% / 37%. As part of the transparency issue, there is no documented explanation for this weighting change. However, as part of this study, Appendix 3 does provide an explanation through paper reference and memorandum from Christensen on the subject.

The Workload Index is a chained index calculation. This means that effectively the current year value is partially based on the previous year's value. This "chaining" limits the impact of a change in the weighting factor on the current year's value. The table below shows the impact of the change in 2016 from 70%/30% to 63%/37%.

Figure 58: Impact of Changing Total Output / Network Weighting Factor in 2016

Year	Published Index Values			Weighting Factor		Possible Range of 2016 Workload			Calculated TFP for 2016 by Weighting Factor			
	Total Output	Network	Workload	Total Output	Network	Calculated Workload	% 2016 Published	+/- 2016 Published	TFP Input	Calculated TFP	Published TFP	Impact on TFP Result
Analysis of 2016 Weighting Change				0.0%	100.0%	1.3095	-0.344%	-0.0045		1.2559		-0.344%
				10.0%	90.0%	1.3102	-0.289%	-0.0038		1.2566		-0.289%
				20.0%	80.0%	1.3110	-0.235%	-0.0031		1.2572		-0.235%
				30.0%	70.0%	1.3117	-0.180%	-0.0024		1.2579		-0.180%
				40.0%	60.0%	1.3124	-0.126%	-0.0017		1.2586		-0.126%
				50.0%	50.0%	1.3131	-0.071%	-0.0009		1.2593		-0.071%
				60.0%	40.0%	1.3138	-0.016%	-0.0002		1.2600		-0.016%
2015	1.107	1.930	1.298									
2016	1.123	1.947	1.314	63.0%	37.0%	1.3140	0.000%	0.0000	1.043	1.2602	1.260	0.000%
% Chg				70.0%	30.0%	1.3145	0.038%	0.0005		1.2607		0.038%
				80.0%	20.0%	1.3153	0.093%	0.0012		1.2614		0.093%
				90.0%	10.0%	1.3160	0.148%	0.0019		1.2621		0.148%
				100.0%	0.0%	1.3167	0.203%	0.0027		1.2628		0.203%

If the network weighting factor had not changed, Workload would have been 1.3145 instead of the published value of 1.3140. The lower Workload Value would have had the result of reducing the published TFP result by 0.038%. This change is limited by the moderate change in Total Output from 2015 to 2016 of 1.43.

This leads to the analysis of how the Workload calculation reacts to the values of the weighting factor. Since this is a chained calculation, the analysis is done for a single pair of values over the entire period of years. This is shown in the following tables. The TFP results are shown in the first table. The what-if results using increments of 10% for the weighting is shown in the second table.

Figure 59: Workload Results with Weighting Factor

Total Output, Network and Workload Indexes								
(indexes based to 1.0 in 1972)								
Year	Total Output Network Workload			Growth Rates (%)			Weighting Factor	
				Total Output	Network	Workload	Total Output	Network
1963	0.842	0.811	0.836					
1964	0.851	0.830	0.847	1.07	2.26	1.32	78.8%	21.2%
1965	0.865	0.852	0.863	1.65	2.63	1.86	78.8%	21.2%
1966	0.913	0.879	0.905	5.33	3.06	4.85	78.8%	21.2%
1967	0.953	0.899	0.942	4.37	2.27	3.92	78.8%	21.2%
1968	0.973	0.917	0.961	2.03	2.04	2.03	78.8%	21.2%
1969	0.991	0.935	0.979	1.81	1.92	1.83	78.8%	21.2%
1970	1.007	0.952	0.995	1.65	1.82	1.69	78.8%	21.2%
1971	1.022	0.974	1.012	1.48	2.22	1.63	78.8%	21.2%
1972	1.000	1.000	1.000	-2.19	2.67	-1.16	78.8%	21.2%
1973	1.014	1.026	1.017	1.41	2.59	1.66	78.8%	21.2%
1974	1.010	1.064	1.021	-0.41	3.58	0.44	78.8%	21.2%
1975	0.990	1.083	1.009	-1.96	1.79	-1.17	78.8%	21.2%
1976	0.955	1.096	0.983	-3.67	1.17	-2.64	78.8%	21.2%
1977	0.969	1.123	1.000	1.50	2.51	1.71	78.8%	21.2%
1978	0.990	1.145	1.021	2.08	1.93	2.05	78.8%	21.2%
1979	0.983	1.175	1.021	-0.63	2.58	0.05	78.8%	21.2%
1980	1.003	1.201	1.042	2.00	2.18	2.04	78.8%	21.2%
1981	0.999	1.218	1.042	-0.41	1.37	-0.03	78.8%	21.2%
1982	0.982	1.236	1.031	-1.74	1.46	-1.06	78.8%	21.2%
1983	1.002	1.255	1.051	2.00	1.57	1.91	78.8%	21.2%
1984	1.068	1.282	1.110	6.39	2.08	5.48	78.8%	21.2%
1985	1.113	1.309	1.152	4.15	2.11	3.72	78.8%	21.2%
1986	1.156	1.329	1.191	3.79	1.54	3.31	78.8%	21.2%
1987	1.198	1.360	1.231	3.57	2.28	3.29	78.8%	21.2%
1988	1.235	1.386	1.266	3.03	1.92	2.79	78.8%	21.2%
1989	1.238	1.409	1.272	0.21	1.59	0.50	78.8%	21.2%
1990	1.281	1.432	1.312	3.48	1.62	3.08	78.8%	21.2%
1991	1.279	1.451	1.314	-0.15	1.33	0.16	78.8%	21.2%
1992	1.282	1.469	1.320	0.25	1.22	0.45	78.8%	21.2%
1993	1.317	1.488	1.352	2.68	1.30	2.39	78.8%	21.2%
1994	1.367	1.510	1.396	3.72	1.48	3.24	78.8%	21.2%
1995	1.382	1.533	1.413	1.07	1.48	1.16	78.8%	21.2%
1996	1.403	1.555	1.434	1.51	1.47	1.50	78.8%	21.2%
1997	1.449	1.575	1.475	3.26	1.27	2.84	78.8%	21.2%
1998	1.488	1.597	1.509	2.63	1.34	2.25	70.0%	30.0%
1999	1.529	1.619	1.544	2.68	1.42	2.31	70.0%	30.0%
2000	1.560	1.645	1.573	2.01	1.55	1.87	70.0%	30.0%
2001	1.539	1.667	1.565	-1.33	1.33	-0.53	70.0%	30.0%
2002	1.489	1.690	1.535	-3.30	1.39	-1.89	70.0%	30.0%
2003	1.466	1.715	1.525	-1.56	1.45	-0.65	70.0%	30.0%
2004	1.486	1.738	1.546	1.37	1.34	1.36	70.0%	30.0%
2005	1.515	1.765	1.575	1.92	1.55	1.81	70.0%	30.0%
2006	1.521	1.792	1.586	0.36	1.50	0.70	70.0%	30.0%
2007	1.507	1.818	1.582	-0.92	1.43	-0.22	70.0%	30.0%
2008	1.438	1.838	1.536	-4.70	1.10	-2.96	70.0%	30.0%
2009	1.270	1.853	1.412	-12.41	0.84	-8.43	70.0%	30.0%
2010	1.208	1.866	1.366	-5.01	0.67	-3.31	70.0%	30.0%
2011	1.180	1.877	1.346	-2.33	0.57	-1.46	70.0%	30.0%
2012	1.141	1.888	1.317	-3.34	0.60	-2.16	70.0%	30.0%
2013	1.125	1.899	1.307	-1.44	0.60	-0.83	70.0%	30.0%
2014	1.100	1.914	1.290	-2.21	0.80	-1.31	70.0%	30.0%
2015	1.107	1.930	1.298	0.61	0.80	0.66	70.0%	30.0%
2016	1.123	1.947	1.314	1.42	0.87	1.21	63.0%	37.0%

Figure 60: Sensitivity Analysis of Workload Weighting Factor

Year	Published Wokload				Result if Weighted Used from Base Year without Change										
	78.80%	70%	63%		100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
Year	21.20%	30%	37%		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1963															
1964															
1965															
1966															
1967															
1968															
1969															
1970															
1971															
1972	1.000				1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1973	1.017				1.014	1.015	1.017	1.018	1.019	1.020	1.021	1.023	1.024	1.025	1.026
1974	1.021				1.010	1.015	1.021	1.026	1.031	1.037	1.042	1.047	1.053	1.058	1.064
1975	1.009				0.990	0.999	1.008	1.017	1.026	1.036	1.045	1.054	1.064	1.073	1.083
1976	0.983				0.955	0.968	0.981	0.995	1.009	1.023	1.037	1.051	1.066	1.081	1.096
1977	1.000				0.969	0.984	0.998	1.013	1.028	1.043	1.059	1.075	1.091	1.107	1.123
1978	1.021				0.990	1.004	1.019	1.034	1.049	1.065	1.080	1.096	1.112	1.129	1.145
1979	1.021				0.983	1.001	1.019	1.037	1.056	1.075	1.094	1.114	1.134	1.155	1.175
1980	1.042				1.003	1.021	1.040	1.059	1.078	1.098	1.118	1.138	1.159	1.180	1.201
1981	1.042				0.999	1.019	1.039	1.060	1.081	1.103	1.125	1.148	1.171	1.194	1.218
1982	1.031				0.982	1.005	1.028	1.052	1.076	1.102	1.127	1.153	1.180	1.208	1.236
1983	1.051				1.002	1.025	1.048	1.072	1.096	1.121	1.147	1.173	1.200	1.227	1.255
1984	1.110				1.068	1.088	1.108	1.128	1.149	1.170	1.191	1.213	1.236	1.258	1.282
1985	1.152				1.113	1.131	1.150	1.169	1.188	1.207	1.227	1.247	1.267	1.288	1.309
1986	1.191				1.156	1.172	1.189	1.206	1.222	1.240	1.257	1.275	1.293	1.311	1.329
1987	1.231				1.198	1.213	1.229	1.245	1.260	1.276	1.293	1.309	1.326	1.343	1.360
1988	1.266				1.235	1.249	1.264	1.279	1.293	1.308	1.324	1.339	1.355	1.370	1.386
1989	1.272				1.238	1.254	1.270	1.287	1.303	1.320	1.338	1.355	1.373	1.391	1.409
1990	1.312				1.281	1.296	1.310	1.325	1.339	1.354	1.370	1.385	1.400	1.416	1.432
1991	1.314				1.279	1.296	1.312	1.329	1.345	1.362	1.380	1.397	1.415	1.433	1.451
1992	1.320				1.282	1.300	1.318	1.336	1.354	1.372	1.391	1.410	1.429	1.449	1.469
1993	1.352				1.317	1.334	1.350	1.366	1.383	1.400	1.417	1.435	1.452	1.470	1.488
1994	1.396				1.367	1.381	1.395	1.409	1.423	1.437	1.451	1.466	1.480	1.495	1.510
1995	1.413				1.382	1.396	1.411	1.426	1.440	1.455	1.470	1.486	1.501	1.517	1.533
1996	1.434				1.403	1.417	1.432	1.447	1.462	1.477	1.492	1.508	1.524	1.539	1.555
1997	1.475				1.449	1.462	1.474	1.486	1.498	1.511	1.524	1.536	1.549	1.562	1.575
1998		1.509			1.488	1.499	1.509	1.520	1.531	1.541	1.552	1.563	1.574	1.585	1.597
1999		1.544			1.529	1.537	1.546	1.555	1.564	1.573	1.582	1.592	1.601	1.610	1.619
2000		1.573			1.560	1.568	1.576	1.585	1.593	1.602	1.610	1.619	1.627	1.636	1.645
2001		1.565			1.539	1.551	1.564	1.576	1.589	1.602	1.614	1.627	1.640	1.653	1.667
2002		1.535			1.489	1.508	1.527	1.547	1.566	1.586	1.607	1.627	1.648	1.669	1.690
2003		1.525			1.466	1.489	1.513	1.537	1.561	1.586	1.611	1.636	1.662	1.688	1.715
2004		1.546			1.486	1.510	1.534	1.558	1.582	1.607	1.633	1.658	1.684	1.711	1.738
2005		1.575			1.515	1.538	1.562	1.586	1.611	1.635	1.661	1.686	1.712	1.738	1.765
2006		1.586			1.521	1.546	1.571	1.597	1.624	1.651	1.678	1.706	1.734	1.763	1.792
2007		1.582			1.507	1.535	1.564	1.594	1.624	1.655	1.686	1.718	1.751	1.784	1.818
2008		1.536			1.438	1.473	1.510	1.547	1.586	1.625	1.666	1.707	1.750	1.793	1.838
2009		1.412			1.270	1.319	1.370	1.422	1.477	1.534	1.593	1.655	1.718	1.785	1.853
2010		1.366			1.208	1.261	1.317	1.376	1.437	1.501	1.568	1.638	1.710	1.786	1.866
2011		1.346			1.180	1.236	1.295	1.356	1.420	1.488	1.559	1.633	1.710	1.791	1.877
2012		1.317			1.141	1.200	1.262	1.327	1.396	1.468	1.544	1.623	1.707	1.795	1.888
2013		1.307			1.125	1.185	1.249	1.316	1.387	1.462	1.540	1.623	1.710	1.802	1.899
2014		1.290			1.100	1.163	1.229	1.299	1.373	1.451	1.534	1.621	1.714	1.811	1.914
2015		1.298			1.107	1.170	1.237	1.308	1.382	1.462	1.545	1.633	1.727	1.825	1.930
2016			1.314		1.123	1.186	1.253	1.324	1.399	1.478	1.562	1.650	1.744	1.842	1.947
					-14.57%	-9.73%	-4.62%	0.77%	6.48%	12.50%	18.87%	25.59%	32.70%	40.21%	48.14%

These results are shown in the following two graphs. One is the Workload based on the weighting increments in the table above. The second shows the impact on TFP based on these increments.

Figure 61: Impact of Weighting Total Output versus Network on Resulting Workload Index

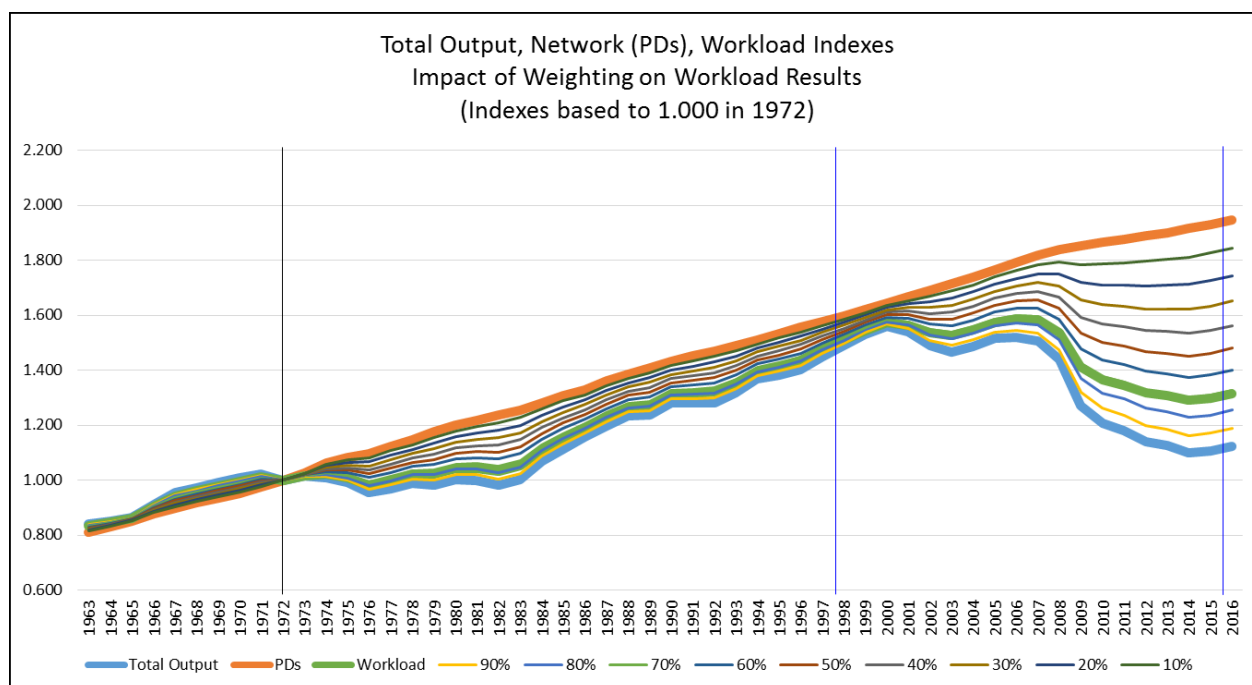
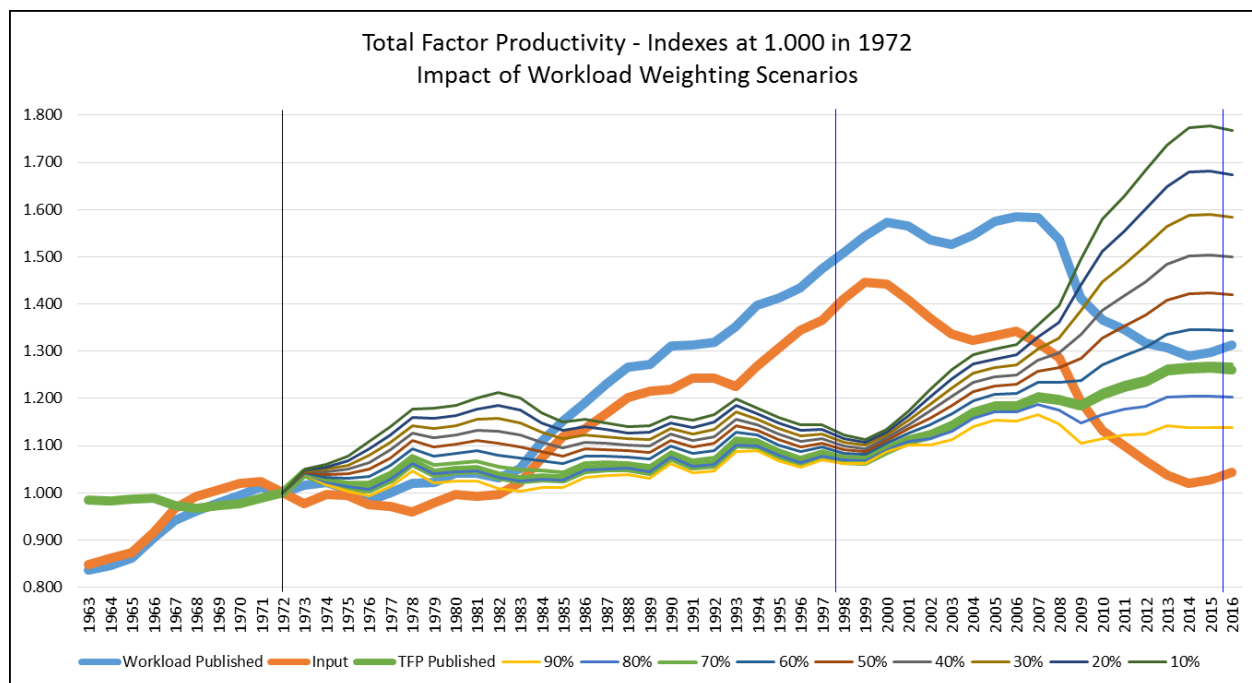


Figure 62: Impact of Weighting Total Output versus Network on TFP Result



The outputs utilize weighted mail volume by using PRC approved attributable costs and miscellaneous output (primarily special services - including P. O. Boxes) plus a factor for the delivery network. In a TFP measure that is designed to be all-inclusive, this list of outputs appears to be “relevant” in attempting to account for all of the outputs.

There are a couple of areas that bear further examination. The current weighting of the delivery network utilizes an entirely separate methodology, compared to the rest of the outputs. It also adjusted sporadically in rather large increments relative to the more gradual continuous adjustments for Output. In addition, the PRC staff has raised concerns about intra-product movements that are not accounted for along with the thought that delivery expansion might occur disproportionately to lower delivery cost options.

The exploration of these topics is addressed in detail in Report 2. This discussion in Report 2 will include an alternative of delivery point weighting using the CRA delivery institutional costs. This alternative may be a more analytical means to weight delivery points.

3. Workhour Composition of Labor Factor

One factor used in the Labor Input methodology is a “composition of labor input” factor to incorporate experience level into the productivity measurement. This factor segments employees into a number of groups based on increments of five years of employment. However, years of seniority may not be a significant factor in productivity performance in the environment of postal operations. The number of years of employment does determine salary level, based on the step structure. However, an employee will “top out” in the salary structure in the second experience group, distorting the impact of wage rate through the factor. The detailed explanation of the Composition of Labor factor as provided in the PRC methodology paper ² is shown in Figure 63.

The value of the composition factor had shown almost no variation over the 54 years of history of its use. It also appears that this composition index has little impact on TFP results. However, the factor did make very large changes in value in 2016 for the first time. Since this Index is calculated in a separate process, the reason behind this large change cannot be validated for this report.

² Page 11, Formulas for Total Factor Productivity, Labor Productivity, Postal Inflation, and the Aggregate Labor Price Index, Electronic Attachment to Postal Service Response to MPA/USPS-T2-3.b, Filed 6/23/2010.

Figure 63: Explanation of Composition of Labor Input

Composition of Labor Input

Using data from the AERF, a labor composition index is computed for most career-employee labor groups. The composition index represents changes in the experience mix over time of employees within the labor group.⁹ Since records for casual employees are not included in the AERF, we are not able to compute a composition index for the seven casual-employee labor groups. We instead assume that the experience mix of casual employees remains unchanged over time.¹⁰

The labor composition indexes for career-employee labor groups are computed monthly,¹¹ and the quarterly and annual labor composition indexes are averages of the appropriate monthly values. Based on the length of time since initial federal government employment as reported in the AERF, we group employees into seven different levels of experience: up to five years, 6-10 years, 11-15 years, 16-20 years, 21-25 years, 26-30 years, and over 30 years.¹² We then tabulate the number of employees in each experience level by labor group. We also use the wage rate information published in the AERF to compute total wages and salaries in each experience level and labor group. The composition index for a labor group is a Tornqvist quantity index of the employees in each experience level, weighted by the total wages and salaries in each level. For 2003, we compute month-over-month chain-weighted Tornqvist indexes to get the initial levels of the labor-group composition indexes. Beginning in 2004, we use SPLY-weighted Tornqvist indexes to compute the composition index levels.

⁹ The composition index is computed because hours worked information is not available by level of experience. Were such information available, we would have made a finer distinction among labor groups by further dividing each of the career-employee labor groups into different experience levels.

¹⁰ Since employees with five or less years of experience are assigned to the same experience cell, it is likely that almost all casual employees would fall into that cell, and that the casual-employee experience mix would not change materially over time.

¹¹ The monthly snapshot is taken from the last pay period occurring in the month.

¹² Due to the fact that the numbers of part-time Vehicle Service Drivers and part-time Vehicle Maintenance Personnel are relatively small, we treated these two groups differently. For part-time Vehicle Service Drivers, we combined all employees with sixteen or more years of service into one cell. For part-time Vehicle Maintenance Personnel, we assume that the experience mix remains constant.

This composition factor appears to add undue complexity to the methodology, possibly even distorting results. The NWPC TFP Model will be used to quantify the impact of removing the Composition of Labor factor. This is designated as Scenario 1. The result of removing it is shown in the Figure 64 as Scenario 1 (as the green line).

The Baseline model is compared to the Published Results to validate the accuracy of the model. For the Labor Input, the NWPC TFP model is almost identical to the Published Results, indicating the model is accurate.

Then, Scenario 1 is run without using the labor composition factor and compared to the Baseline model. The results of Scenario 1 compared to the Baseline model confirm that the Composition of Labor Index has had negligible impact on the Labor Quantity until the past five (5) years. However, a large change in the factor in 2016 did have an observable impact.

Finally, the elimination of the Composition of Labor factor would allow the Labor Index to be calculated using readily available accounting data rather than the special reports necessary to categorize effectively all of the Postal Service employees into 5-year seniority groupings. This could lead to inclusion of the cost weighted workhours into ongoing management processes. For example, Deliveries per Hour could be based on a TFP oriented Input rather than just unadjusted workhours.

4. Inclusion of a Wage Rate Factor

The Composition of Labor is in some ways a proxy for wage rate. The wage rate is not directly included as an underlying factor. It is, instead, reflected in the Value component as total dollars. One question about TFP effectiveness concerns how it reflects changes in both wage rates, especially in regards to the substitution of career employees with non-career employees. Stated differently, does the methodology account for the substitution of higher wage employees for lower wage employees that perform the same work?

The Postal Service has used this strategy in operations over the past six years through collective bargaining changes. For example, Clerk non-career hours have moved from 3.1% of total Clerk / Mail Handler hours in 2010 to 14.1% in 2016. The non-career Clerk wage rate ratio to a full-time Clerk career wage rate for 2016 is 0.422.

An analysis was done for Clerks / Mail Handlers from 2005 through 2016 to examine the impact of the wage rate and the change from career to non-career employees. This data is shown as Figure 65 and Figure 66.

A key question is how well TFP reacts to these changes in wage rates and changes in the number of hours by employee category, i.e., career versus non-career. The analysis for Clerks / Mail Handlers was done to examine this question.

As an alternative methodology to provide another measure of productivity comparison, the example calculates a "Current Year Indexed Workhours". This method uses the Clerk Full-time wage rate as a base to index the other employee category wages rates within the same year. For example, a non-career Mail Handler is 0.376 of a Full-time clerk wage rate in 2016. By multiplying the workhours by this index, an "Indexed Workhour" metric can be created.

Figure 66 shows the results of this analysis. Using the simple percentage change calculation, the results show that workhours were -33.7% from 2005 to 2016. The Indexed Workhours were -36.5%, showing that the increased use of lower wage employees did have an observable impact. The Published TFP Quantity showed -39.3%, confirming that the changes in hour mix and wage rate are reflected in the methodology. The NWPC TFP Model Scenario 1, removing the Composition factor, showed -37.6%. Given the significant change in the Composition factor in the past several years, as stated previously, further analysis of HAT results is needed to further explain the difference.

This analysis documents that in general terms, wage rates and hour mix are reflected in the TFP Labor Index results. The Report 2 process provides additional analysis of this issue.

Figure 64: NWPC TFP Model Results - Scenarios 1, 2 & 3 as Compared to Baseline / Published

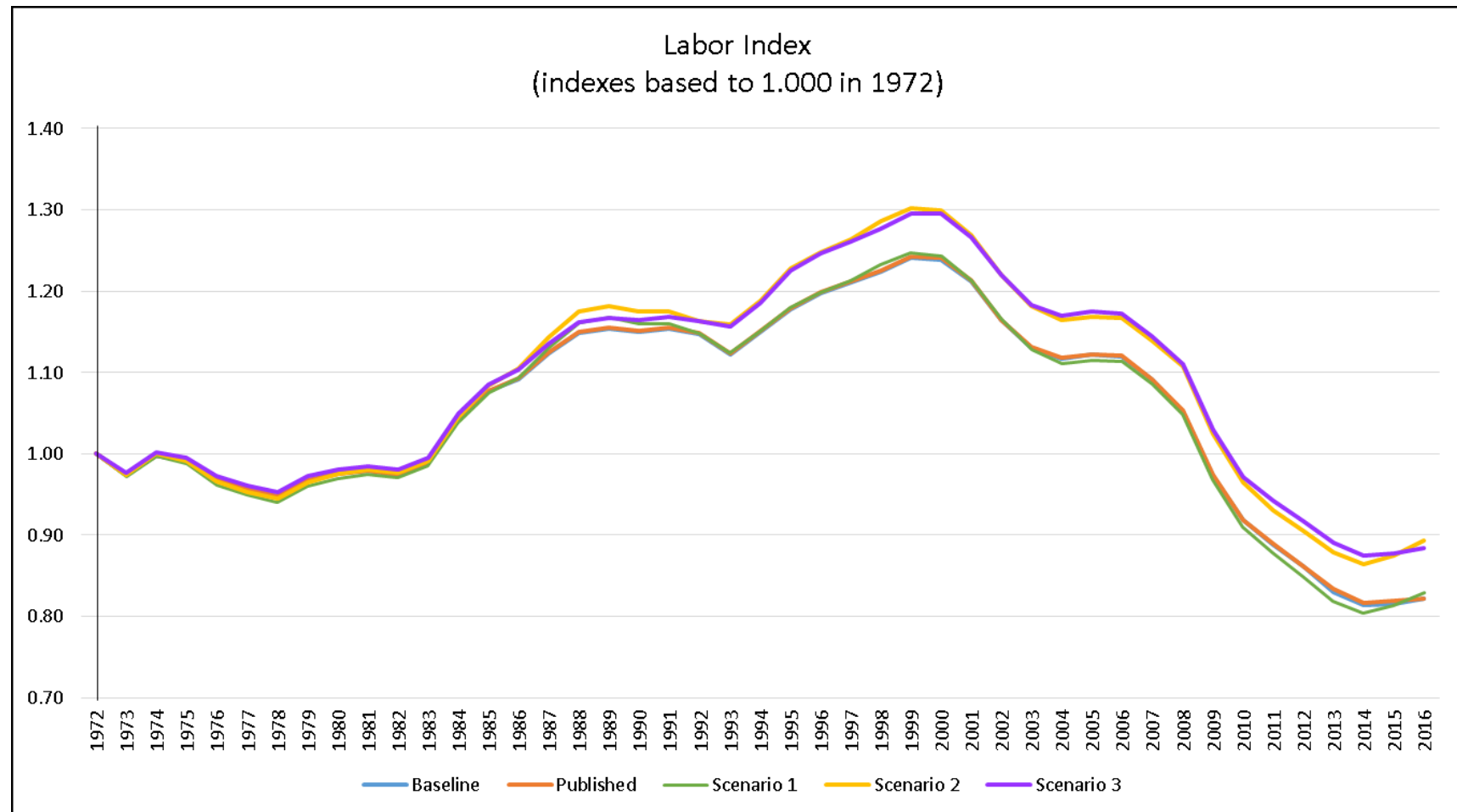


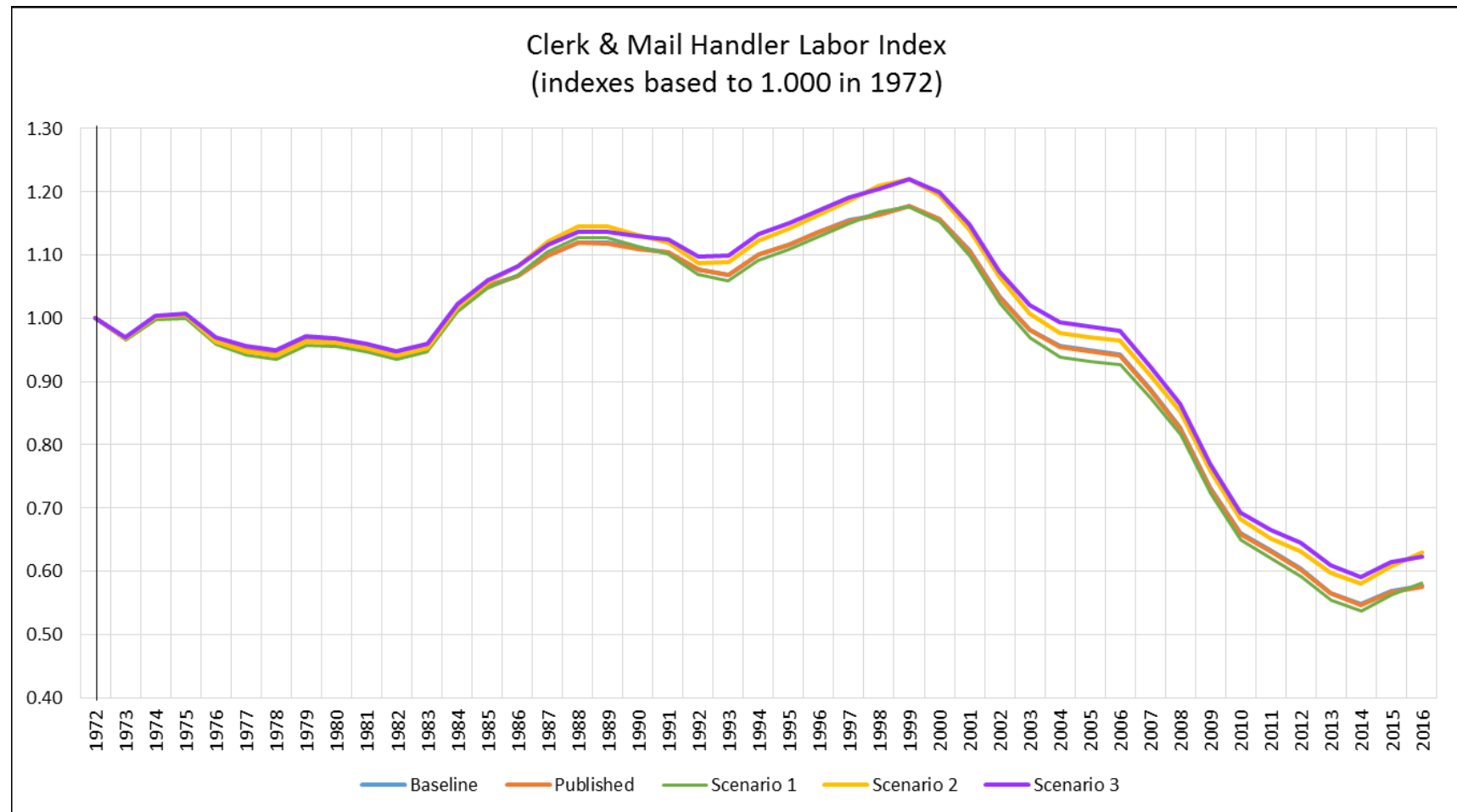
Figure 65: Analysis of Labor Quantity Methodology – Clerks / Mail Handlers 2005 - 2016

Analysis of Labor Quantity - Clerks / Mail Handlers - 2005 to 2016																
Year	Clerks							Mailhandlers								
	Full-time			Part Time			Non-Career	Full-time			Part Time			Total Career		
	Hours	Comp Index	Value - Dollars	Hours	Comp Index	Value - Dollars	Hours Value - Dollars	Hours	Comp Index	Value - Dollars	Hours	Comp Index	Value - Dollars	Hours	Comp Index	Value - Dollars
	Souce Data															
2005	323.1	1.008	12656.2	77.8	1.007	2654.0	37.8 548.6	95.7	1.006	3590.0	9.5	1.022	284.7			11.9 160.1
2006	317.5	1.008	13006.9	79.8	0.998	2794.5	32.1 471.4	98.1	1.004	3841.3	10.2	1.008	308.4			12.3 173.6
2007	298.4	1.006	12766.4	71.0	1.001	2674.3	30.5 469.7	97.5	1.001	4017.1	9.2	1.002	295.7			12.4 187.5
2008	291.4	1.002	12749.7	51.6	1.008	2041.1	26.3 413.5	93.3	0.997	3961.9	7.5	0.984	242.4			10.2 156.0
2009	263.5	1.002	12369.5	43.3	1.011	1871.2	14.4 232.7	85.0	0.998	3905.4	5.7	0.999	214.3			4.4 67.7
2010	232.2	1.004	11080.1	40.5	1.020	1792.1	11.4 174.1	80.3	1.001	3775.4	5.1	1.020	208.3			3.4 47.9
2011	221.0	1.005	11014.4	36.4	1.031	1707.4	13.1 212.8	78.2	1.006	3890.5	4.8	1.047	218.2			5.5 81.3
2012	218.9	1.005	11135.2	21.2	1.038	1028.1	23.2 473.9	75.0	1.009	3888.4	4.1	1.076	199.6			8.0 120.9
2013	197.6	1.005	10340.4	19.7	1.037	976.2	38.4 821.9	70.5	1.009	3710.3	2.4	1.068	121.8			12.6 214.6
2014	190.0	1.000	10012.2	19.0	1.032	942.4	41.4 907.1							70.0	1.015	3663.2
2015	197.3	0.992	10306.5	24.7	1.032	1061.9	46.0 1000.8							69.7	1.005	3674.6
2016	200.2	0.972	10561.9	28.9	1.032	1210.4	51.9 1155.0							71.2	0.976	3764.8
Share of Hours / Wage Rate																
2005	58.1%		\$ 39.17	14.0%		\$ 34.09	6.8% \$ 14.51	17.2%		\$ 37.53	1.7%		\$ 29.92			2.1% \$ 13.43
2006	57.7%		\$ 40.97	14.5%		\$ 35.00	5.8% \$ 14.70	17.8%		\$ 39.16	1.9%		\$ 30.16			2.2% \$ 14.16
2007	57.5%		\$ 42.78	13.7%		\$ 37.68	5.9% \$ 15.40	18.8%		\$ 41.21	1.8%		\$ 32.29			2.4% \$ 15.11
2008	60.7%		\$ 43.76	10.7%		\$ 39.56	5.5% \$ 15.73	19.4%		\$ 42.46	1.6%		\$ 32.19			2.1% \$ 15.31
2009	63.3%		\$ 46.95	10.4%		\$ 43.17	3.4% \$ 16.20	20.4%		\$ 45.94	1.4%		\$ 37.38			1.1% \$ 15.34
2010	62.3%		\$ 47.72	10.9%		\$ 44.20	3.1% \$ 15.29	21.5%		\$ 47.03	1.4%		\$ 40.56			0.9% \$ 14.21
2011	61.6%		\$ 49.83	10.1%		\$ 46.85	3.6% \$ 16.24	21.8%		\$ 49.73	1.3%		\$ 45.36			1.5% \$ 14.83
2012	62.5%		\$ 50.87	6.1%		\$ 48.46	6.6% \$ 20.46	21.4%		\$ 51.88	1.2%		\$ 49.00			2.3% \$ 15.15
2013	57.9%		\$ 52.34	5.8%		\$ 49.57	11.3% \$ 21.41	20.7%		\$ 52.63	0.7%		\$ 50.26			3.7% \$ 16.98
2014	56.5%		\$ 52.70	5.7%		\$ 49.50	12.3% \$ 21.89							20.8%		\$ 52.34
2015	55.8%		\$ 52.22	7.0%		\$ 42.96	13.0% \$ 21.76							19.7%		\$ 52.71
2016	54.3%		\$ 52.75	7.8%		\$ 41.83	14.1% \$ 22.25							19.3%		\$ 52.85
Index Hours = Hours / Index of Clerks FT Wage Rate Base to Category Wage Rate																
2005	323.1	1.000	1.000	67.8	0.870	14.0 0.371	91.7 0.958	7.3 0.764								4.1 0.343
2006	317.5	1.000	1.000	68.2	0.854	11.5 0.359	93.8 0.956	7.5 0.736								4.2 0.346
2007	298.4	1.000	1.000	62.5	0.881	11.0 0.360	93.9 0.963	6.9 0.755								4.4 0.353
2008	291.4	1.000	1.000	46.6	0.904	9.4 0.359	90.5 0.970	5.5 0.736								3.6 0.350
2009	263.5	1.000	1.000	39.9	0.920	5.0 0.345	83.2 0.979	4.6 0.796								1.4 0.327
2010	232.2	1.000	1.000	37.6	0.926	3.6 0.321	79.1 0.986	4.4 0.850								1.0 0.298
2011	221.0	1.000	1.000	34.3	0.940	4.3 0.326	78.1 0.998	4.4 0.910								1.6 0.298
2012	218.9	1.000	1.000	20.2	0.953	9.3 0.402	76.4 1.020	3.9 0.963								2.4 0.298
2013	197.6	1.000	1.000	18.7	0.947	15.7 0.409	70.9 1.006	2.3 0.960								4.1 0.324
2014	190.0	1.000	1.000	17.9	0.939	17.2 0.415								69.5		0.993
2015	197.3	1.000	1.000	20.3	0.823	19.2 0.417								70.4		1.009
2016	200.2	1.000	1.000	22.9	0.793	21.9 0.422								71.4		1.002

Figure 66: Analysis of Labor Quantity Methodology – Clerks / Mail Handlers 2005 - 2016

	Analysis of Labor Quantity - Clerks / Mail Handlers - 2005 to 2016																			
Year	Clerks and Mailhandlers				Removed Comp Index		Current Yr Weighting		Both		Clerks and Mailhandlers				Removed Comp Index		Current Yr Weighting		Both	
	Hours	Indexed Hours	Value - Dollars	Wage Rate	Published Quantity	Model 1 Quantity	Model 2 Quantity	Model 3 Quantity	Hours	Indexed Hours	Value - Dollars	Wage Rate	Published Quantity	Model 1 Quantity	Model 2 Quantity	Model 3 Quantity				
									Quantity Indexed to 2005											
2005	555.9		19893.5	\$ 35.79	3337.2	3280.8	3476.5	3413.4	1.000	1.000	1.000		1.000	1.000	1.000	1.000				
2006	550.0		20596.1	\$ 37.45	3311.7	3261.1	3451.8	3394.8	0.989	0.990	1.035		0.992	0.994	0.993	0.995				
2007	518.9		20410.7	\$ 39.33	3119.5	3075.7	3252.9	3203.3	0.934	0.939	1.026		0.935	0.937	0.936	0.938				
2008	480.3		19564.6	\$ 40.73	2903.4	2870.5	3040.1	3002.4	0.864	0.880	0.983		0.870	0.875	0.874	0.880				
2009	416.3		18660.7	\$ 44.82	2572.6	2542.3	2704.7	2669.8	0.749	0.783	0.938		0.771	0.775	0.778	0.782				
2010	372.9		17077.9	\$ 45.80	2318.1	2284.5	2439.0	2401.0	0.671	0.705	0.858		0.695	0.696	0.702	0.703				
2011	359.1		17124.5	\$ 47.69	2221.8	2182.0	2339.8	2295.4	0.646	0.677	0.861		0.666	0.665	0.673	0.672				
2012	350.3		16846.0	\$ 48.09	2120.8	2080.1	2267.5	2221.9	0.630	0.652	0.847		0.635	0.634	0.652	0.651				
2013	341.2		16185.1	\$ 47.44	1986.3	1947.9	2143.9	2100.4	0.614	0.609	0.814		0.595	0.594	0.617	0.615				
2014	336.2		15819.7	\$ 47.06	1922.3	1892.3	2078.1	2042.7	0.605	0.591	0.795		0.576	0.577	0.598	0.598				
2015	353.8		16348.0	\$ 46.20	1997.5	1981.4	2161.4	2140.8	0.637	0.616	0.822		0.599	0.604	0.622	0.627				
2016	368.7		17016.5	\$ 46.16	2025.3	2047.3	2193.5	2213.7	0.663	0.635	0.855		0.607	0.624	0.631	0.649				
	Comparison to Published Quantity								% Change (Common Formula)											
2005						-1.69%	4.17%	2.28%												
2006						-1.53%	4.23%	2.51%	-1.1%	-1.0%	3.5%	4.6%	-0.8%	-0.6%	-0.7%	-0.5%				
2007						-1.40%	4.28%	2.69%	-5.6%	-5.1%	-0.9%	5.0%	-5.8%	-5.7%	-5.8%	-5.6%				
2008						-1.13%	4.71%	3.41%	-7.4%	-6.3%	-4.1%	3.6%	-6.9%	-6.7%	-6.5%	-6.3%				
2009						-1.18%	5.13%	3.78%	-13.3%	-11.1%	-4.6%	10.0%	-11.4%	-11.4%	-11.0%	-11.1%				
2010						-1.45%	5.21%	3.57%	-10.4%	-10.0%	-8.5%	2.2%	-9.9%	-10.1%	-9.8%	-10.1%				
2011						-1.79%	5.31%	3.31%	-3.7%	-4.0%	0.3%	4.1%	-4.2%	-4.5%	-4.1%	-4.4%				
2012						-1.92%	6.92%	4.77%	-2.5%	-3.6%	-1.6%	0.8%	-4.5%	-4.7%	-3.1%	-3.2%				
2013						-1.94%	7.94%	5.74%	-2.6%	-6.6%	-3.9%	-1.4%	-6.3%	-6.4%	-5.4%	-5.5%				
2014						-1.56%	8.10%	6.26%	-1.5%	-2.9%	-2.3%	-0.8%	-3.2%	-2.9%	-3.1%	-2.7%				
2015						-0.81%	8.20%	7.17%	5.3%	4.3%	3.3%	-1.8%	3.9%	4.7%	4.0%	4.8%				
2016						1.09%	8.30%	9.30%	4.2%	3.1%	4.1%	-0.1%	1.4%	3.3%	1.5%	3.4%				
							2005 to 2016		-33.7%	-36.5%	-14.5%	29.0%	-39.3%	-37.6%	-36.9%	-35.1%				
	Calculation of Indexed Hours								% Growth Rate (Logarithm formula)											
2005		507.9																		
2006		502.7							-1.1%	-1.0%	3.5%	4.5%	-0.8%	-0.6%	-0.7%	-0.5%				
2007		477.1							-5.8%	-5.2%	-0.9%	4.9%	-6.0%	-5.9%	-5.9%	-5.8%				
2008		447.1							-7.7%	-6.5%	-4.2%	3.5%	-7.2%	-6.9%	-6.8%	-6.5%				
2009		397.5							-14.3%	-11.8%	-4.7%	9.6%	-12.1%	-12.1%	-11.7%	-11.7%				
2010		357.9							-11.0%	-10.5%	-8.9%	2.2%	-10.4%	-10.7%	-10.3%	-10.6%				
2011		343.6							-3.8%	-4.1%	0.3%	4.0%	-4.2%	-4.6%	-4.2%	-4.5%				
2012		331.2							-2.5%	-3.7%	-1.6%	0.8%	-4.7%	-4.8%	-3.1%	-3.3%				
2013		309.2							-2.6%	-6.8%	-4.0%	-1.4%	-6.5%	-6.6%	-5.6%	-5.6%				
2014		300.2							-1.5%	-3.0%	-2.3%	-0.8%	-3.3%	-2.9%	-3.1%	-2.8%				
2015		313.0							5.1%	4.2%	3.3%	-1.8%	3.8%	4.6%	3.9%	4.7%				
2016		322.6							4.1%	3.0%	4.0%	-0.1%	1.4%	3.3%	1.5%	3.4%				
							2005 to 2016		-41.1%		-15.6%	25.4%	-49.9%	-47.2%	-46.1%	-43.3%				

Figure 67: NWPC TFP Model Results – Clerk / Mail Handler Labor Index



5. Symmetric 2-Year Weighting Index

The Tornqvist Index formula is used to calculate the Quantity index in the TFP process. For Labor, it measures the change in the number of Composition Hours as a ratio of the Current Year divided by the Previous Year, raised to the power of the average of the percentage of cost (dollars) over the two years. This method is called a symmetric index because the percentage of cost is weighed equally in the formula. This results in a smoothing effect on the results.

One qualitative observation by managers of TFP over the years is that it does not immediately respond to changes that occurred for the year. As a potential methodological alternative, a scenario was identified to weight the ratio of hours solely on the percent of the current year's cost. In simple terms, remove the averaging of the two years percent cost in the exponent and only use the current year. We identified this as Scenario 3 in Figure 66. Scenario 2 was the combination of removing the Composition factor and using only current year weighting.

Figure 64 shows the results from the NWPC TFP model for Scenarios 2 (orange line) and Scenario 3 (purple line). In general, the result shows a growing gap in the value over the years, but no change in the basic trend. There is no shifting of results from one year to the next, especially where significant changes in value or cost occur in a particular year.

This demonstrates that the result of the symmetric weighting does smooth the results, leading to lower values in growth. A change to current year weighting would show higher levels of growth in the TFP data set. The relative change would still follow the same trend.

The conclusion is that the symmetric weighting in the index process should not be changed. Substantial work would be required to recast results, particularly for the other Input and Output categories. Plus the implications of all of these changes would need to be fully understood before such a modification could be made. If a new TFP model were to be developed, this factor might be considered in the design.

6. Restructure Mail Volume Category Components

The Mail Product Categories used for reporting are comprised of segments of the traditional Mail Classes. All of the significant mail classification changes including the PAEA realignment to Products and movement of some parcel categories from Market Dominant to Competitive Mail Classification have had implications for the TFP methodology and required significant adjustments.

In a related matter, there have been a number of presort changes that occur below the mail categories used in TFP reporting. One question about productivity is the impact of implementing detailed workshare changes over the years in a manner that would not be directly picked up by the TFP mail categories that are reporting. For example, any changes from 3-digit to 5-digit sorting are not segregated in the TFP data categories. It could potentially be problematic to gather the historical data (including the volumes of these presort categories along with the associated cost avoidances over the many years covered by TFP.

It is also likely that the net impact would not be realized, as in general, the aggregation in a Tornqvist process does not readily react to different categorization of the same data. However, the different categorization might provide better analytical reports that would be useful in understanding the contribution of specific categories.

With that in mind, the NWPC TFP Model can be used to regroup the Mail Class categories to create different groupings for analysis. Two scenarios that are of interest are as follows:

- First Class into Presort and Non-Presort categories
- Standard into Carrier Preparation and Sort Preparation categories.

This analysis is done in Report 2 process.

7. Create an Operations Oriented Sub-Index

The Aggregate Input Index is based on the Labor, Materials, and Capital. There are two primary results indicators – Total Factor Productivity and the Labor Productivity Index. A new Operations oriented Index could be created through components of Labor and Materials.

In Labor, there are two basic groups – Operations and Indirect. Operations would comprise Clerks / Mail Handlers, City Carriers / Vehicle Service Drivers, and Rural Carriers. Maintenance Service and Vehicle Service might be included in this Operations group. All other Labor classifications could be considered Indirect.

Materials can be grouped into Transportation and Not-Transportation groupings. Transportation represents over half of the Material category. It is directly related to Operations and can be used in a more detailed analysis.

In Report 2, this “Operations Productivity Index” is created using the existing TFP data elements.

8. Change Base Year

TFP covers a 54-year period. Generally, the results use 1972 as a base year. Using 1972 has some logic as it is essentially the first full year the modern Postal Service operated under the Postal Reorganization Act. At the same time, this means that all of the calculations are utilizing a 45 year-old base period with relatively less relevant interim years leading up to the present day. The Mail Volume and Miscellaneous Output Quantities were reset in 2008, resulting in some adjustment factors to transition the metrics.

In a pure chained Tornqvist index, changing the base years only shifts the value up or down. The index is based on the year-to-year changes, with a seed year setting the starting value. But TFP is a mixed metric, using both chained indexes and base year indexes.

As part of Report 2, the methodology for changing the base year to 1990 is presented. It uses a Before / After TFP Model to reset mail volume quantities to 1990 and to calculate new index combinations.

VI. Summary of Report 1 Process

1. Summary of Report 1

Report 1 described the TFP model development and validation process. The TFP model and methodology was validated, with no concerns identified regarding methodology or process validity.

An important part of the report is to explain and document the model. To that end, using 2010 as an example, underlying calculations along with explanatory documentation are provided. The end result is that the reader will understand how the TFP model works. With that as a backdrop, the published results are provided in a more user-friendly format along with an analysis of the results.

Key questions relate to the accuracy and relevance of the TFP model. Northwest Postal Consulting concludes that TFP is complete and accurate in calculations. Moreover, the wealth of data available makes it relevant for a variety of analytical uses. The only aspect that appears open to more consideration is the appropriate weighting of mail volume and deliveries for the creation of a composite workload. This issue is reviewed in detail in Report 2.

The issue of transparency remains, however. Not only is the model complex and difficult to follow in the current format, there is little, if any, public documentation available that explains the inner-workings of TFP. As a result, it is not widely understood beyond a general conceptual level.

There are several changes that could potentially improve the TFP process. These include the following:

1. Improve the reporting and the use of the results.
2. Review the weighting factor used for final workload and other alternatives to workload, such as Total Output per Delivery.
3. Eliminate the Composition of Labor factor.
4. Create an operations oriented sub-index which better reflects how postal operations inputs affect various measures of productivity and examines how TFP tracks with postal operations measures such as delivery per hour.
5. Look at the impact of moving from a 45-year old base (1972) to one more current for comparison purposes.

This report is intended to set the stage for Report 2. Now that confidence in the TFP process has been established, Report 2 will use the TFP methodology and results to assess productivity in the Before and After PAEA periods.

2. Transition to Report 2 – Before / After PAEA

Report 2 will build directly on the results from the NWPC TFP model development and results from the Report 1 process. The approach for determining the productivity for Before / After PAEA study included the following actions.

1. Based on the results of Report 1 and PRC feedback, the scenarios defined here were refined and new analysis aspects were identified. This includes an update of the Underlying, Exogenous and Pricing factors.
2. The NWPC TFP model was updated to accommodate the Before/After analysis structure and the scenario analysis. The validation issues were finalized and an acceptable baseline result from the updated model was established.
3. Report 2 uses 1990 as the base year for the analysis. Reports and results were restructured to this 1990 base year approach.
4. Report 2 focused on an analysis of TFP Before and After the implementation of PAEA. Report 2 segmented the Before and After Periods more finely based upon different TFP trends within those broader periods. That analysis included how Underlying, Exogenous, and Pricing factors influenced the productivity trends.

VII. Appendix Listing

The following are provided as Appendix to this report.

Appendix 1 Consolidated TFP Data Set – 2016 Final

Appendix 2 Single Year Example

Appendix 3 TFP Methodology – Reference Documents

Appendix 4 Alternative Methodology for the Workload Weighting Factor

Appendix 5 NWPC TFP Model – Version 2 (Excel File)

Appendix 6 Graphs Used in Reports 1 & 2 (Excel File)